NASA Plum Brook Station
Wind Assessment Study
September 2007 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Data Analysis Technician
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

On August 21 and 22, 2007, a 50 meter (m) meteorological tower was installed at the NASA Plum Brook Station (PBS) located near Sandusky, Ohio. The tower is the culmination of several years of planning by members of NASA and Green Energy Ohio (GEO). NASA PBS became the 8th site in the state of Ohio for inclusion in GEO's public Ohio Wind Resource Database.

The goals of the wind monitoring study are to determine if it is feasible to erect a wind turbine at PBS, and if so, the corresponding power output that could be obtained. According to Mr. Henry Wroblewski, Glenn Research Center Energy Program Manager, NASA is working in response to the Energy Policy Act of 2005 to reach the goal of achieving 3% of its electricity needs from renewable energy sources. This federal requirement will increase to 5% in 2009 and 7.5% in 2012. NASA would also like to reduce its electricity costs.

Following installation, no problems have been encountered thus far in acquiring the data. Preliminary results for the month of September 2007 are summarized in Section 2. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Data Analysis Summary

Wind data collected during the month of September 2007 are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	6.5	2.9	7.5	3.4	18.3	0.25
2	98	29.9	291	6.5	2.9	7.5	3.4	18.0	0.24
3	131	39.9	201	7.5	3.4	8.7	3.9	27.7	0.23
4	131	39.9	291	7.8	3.5	8.8	3.9	29.3	0.20
5	164	50.0	201	9.0	4.0	10.2	4.6	45.1	0.18
6	164	50.0	291	9.0	4.0	10.1	4.5	44.3	0.18

Shear Exp	Channels	Exponent from Average of Wind Shear Column	Exponent from Average Wind Speed
Exp1	1 to 3	0.5077	0.5123
Exp2	3 to 5	0.8978	0.8050
Exp3	2 to 4	0.6741	0.6305
Exp4	4 to 6	0.6166	0.6237

Figure 1: Daily Average Wind Speeds for September 2007.

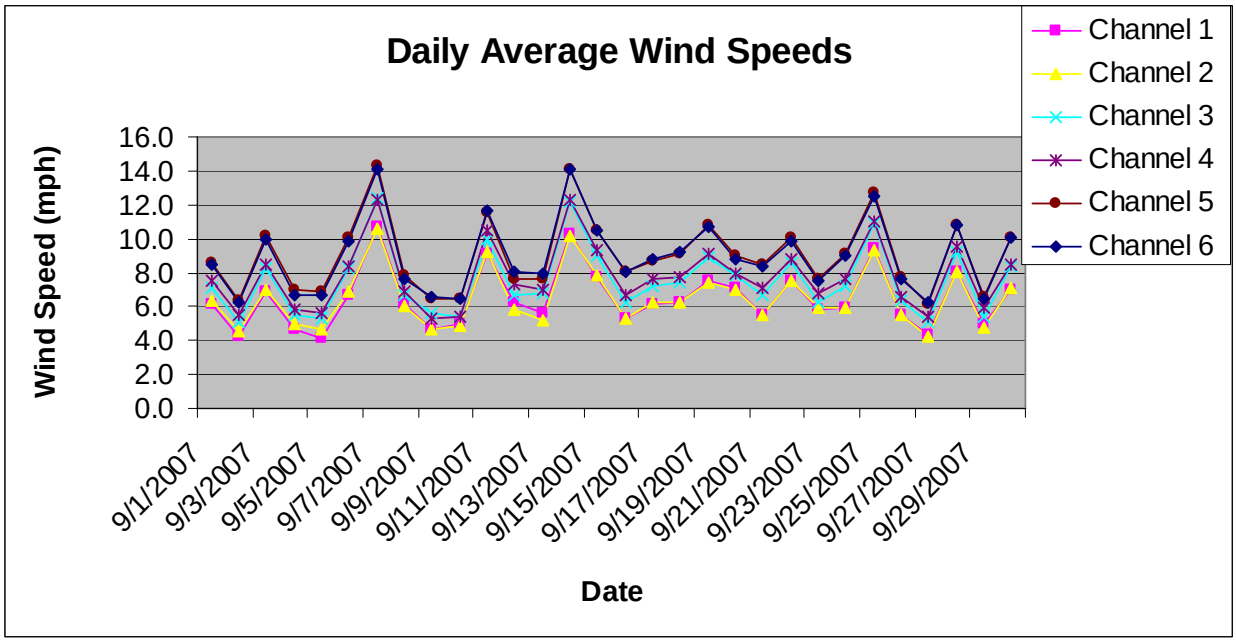
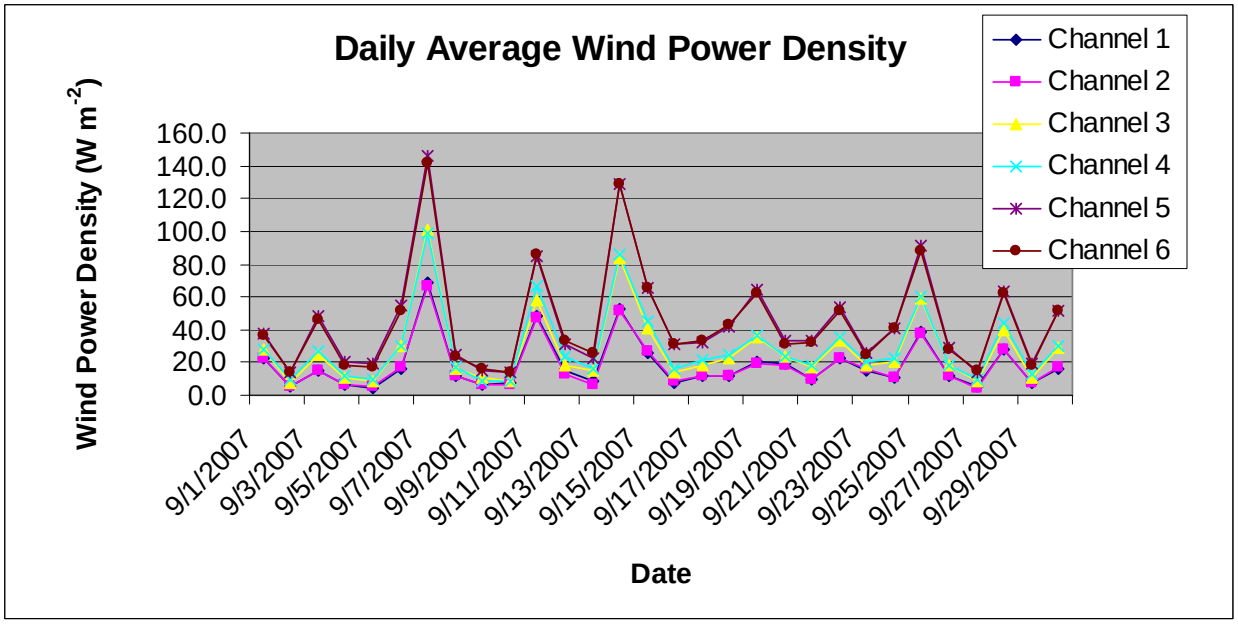


Figure 2: Daily Average Wind Power Density for September 2007.



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name: NASA Plum Brook
Installation Date: August 21 and 22, 2007
Tower Owner: Green Energy Ohio
Site Location (description): Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates): N 41.3716 ^{o} ; W 82.6503^{o}
Ground Elevation: 696 ft
Prevailing Wind Direction: 202.5^{o} (from Ohio Wind Explorer)
Site Sponsor Contacts: Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell
Logger Lock Combination: N/A

TOWER

FCC Tower Registration: None - (50 meter temporary met tower)
Height of structure: 164 ft
Nominal Boom Heights: 30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

NASA Plum Brook Station
Wind Assessment Study
October 2007 Monthly Summary Report

Prepared by:

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1. Site Status

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Wind data collected during the month of October 2007 are summarized below in Table 1 and Figures 1 and 2.

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Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	8.4	3.7	10.2	4.5	45.0	0.25
2	98	29.9	291	8.4	3.8	10.1	4.5	44.5	0.24
3	131	39.9	201	9.6	4.3	11.4	5.1	63.3	0.22
4	131	39.9	291	9.7	4.4	11.3	5.1	62.7	0.20
5	164	50.0	201	11.1	5.0	12.8	5.7	90.8	0.18
6	164	50.0	291	11.1	5.0	12.8	5.7	89.6	0.18

Shear Exp	Channels	Exponent from Average of WShr Column	Exponent from Average Wind Speed
Exp1	1 to 3	0.4772	0.4680
Exp2	3 to 5	0.7418	0.6594
Exp3	2 to 4	0.5814	0.5106
Exp4	4 to 6	0.5898	0.5908

Figure 1: Daily Average Wind Speeds for October 2007.

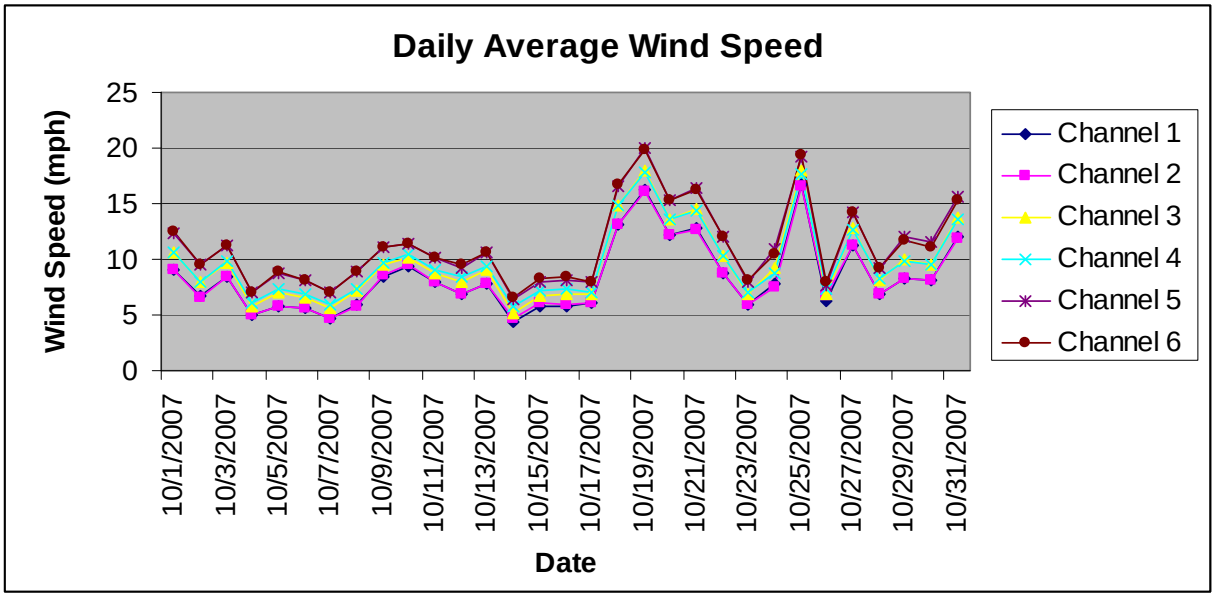
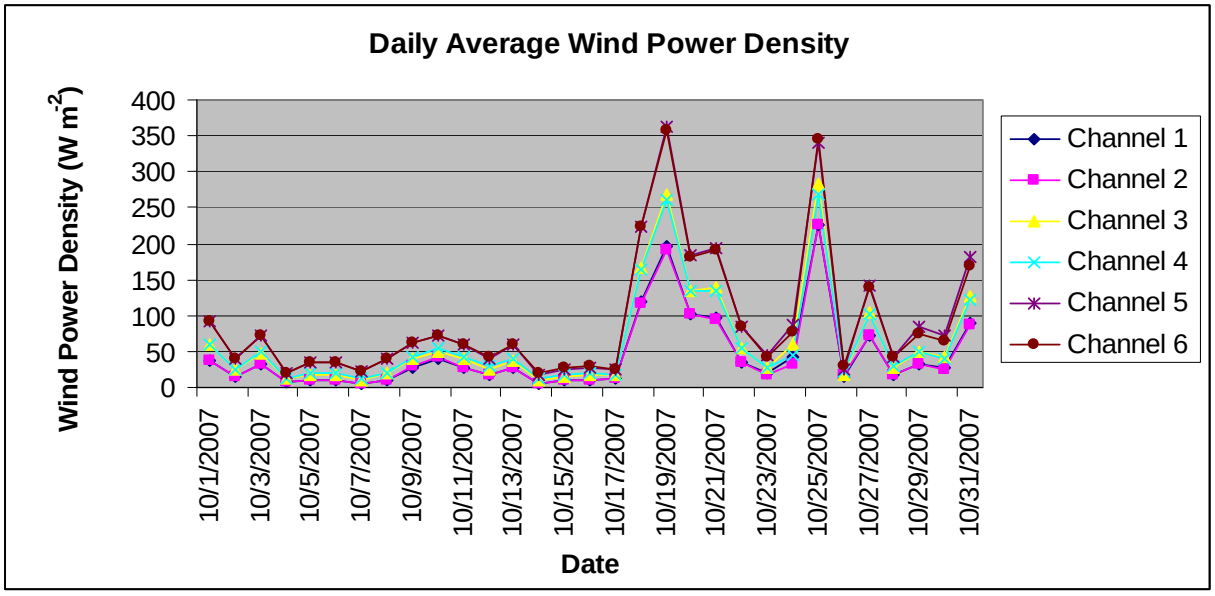


Figure 2: Daily Average Wind Power Density for October 2007.



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Ground Elevation: 696 ft
Prevailing Wind Direction: 202.5^{o} (from Ohio Wind Explorer)
Site Sponsor Contacts: Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
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Logger Lock Combination: N/A

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FCC Tower Registration: None - (50 meter temporary met tower)
Height of structure: 164 ft
Nominal Boom Heights: 30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

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Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

NASA Plum Brook Station
Wind Assessment Study
November 2007 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Data Analysis Technician
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Wind data collected during the month of November 2007 are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	8.9	4.0	10.9	4.9	57.7	0.25
2	98	29.9	291	9.2	4.1	11.1	5.0	60.3	0.23
3	131	39.9	201	10.3	4.6	12.1	5.4	78.8	0.21
4	131	39.9	291	10.3	4.6	12.1	5.4	77.8	0.20
5	164	50.0	201	11.6	5.2	13.4	6.0	107.1	0.18
6	164	50.0	291	11.5	5.1	13.3	6.0	104.9	0.18
Shear Exp	**Channels**	**Exponent from Avg of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.6119	0.4960						
Exp2	3 to 5	0.6058	0.5338						
Exp3	2 to 4	0.4305	0.3756						
Exp4	4 to 6	0.5112	0.5064						

Figure 1: Daily Average Wind Speeds for November 2007.

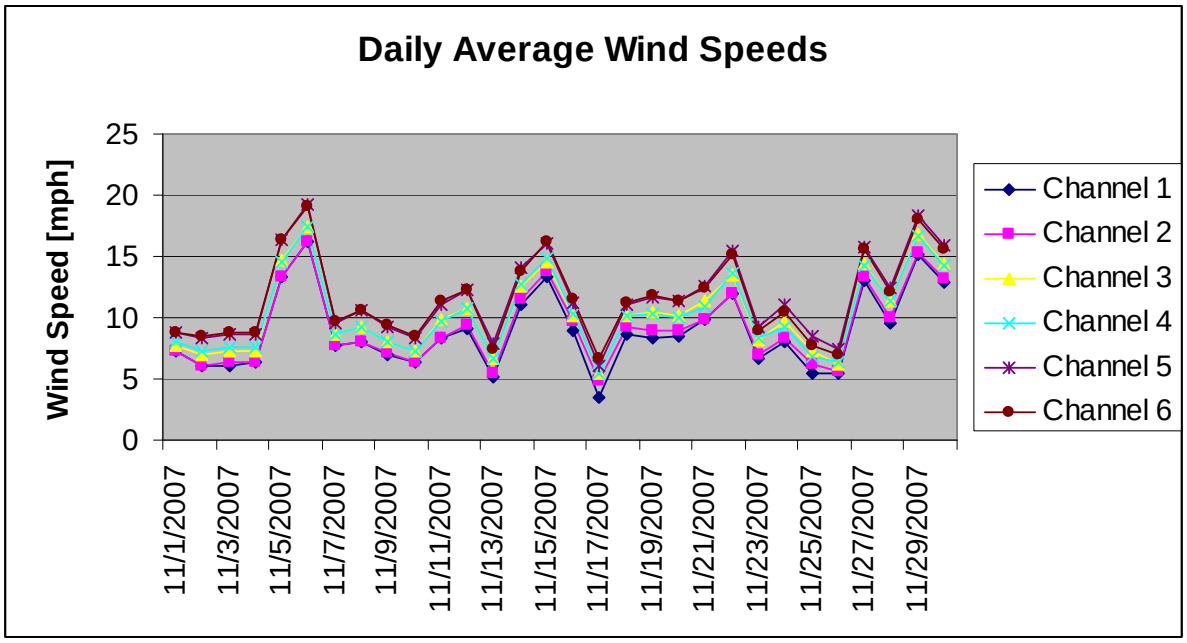
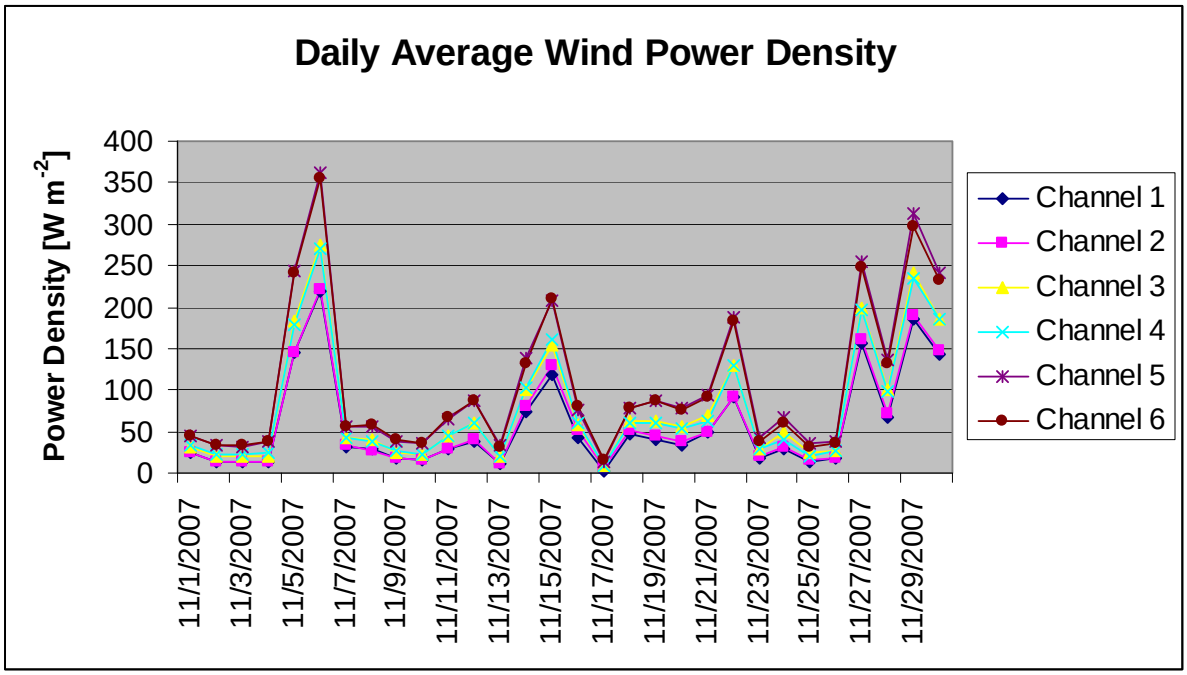


Figure 2: Daily Average Wind Power Density for November 2007.



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Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell
Logger Lock Combination: N/A

TOWER

FCC Tower Registration: None - (50 meter temporary met tower)
Height of structure: 164 ft
Nominal Boom Heights: 30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

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Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

NASA Plum Brook Station
Wind Assessment Study
December 2007 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Data Analysis Technician
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

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Following installation, no problems have been encountered thus far in acquiring the data with the exception of an icing event on December 16, 2008. Preliminary results for the month of December 2007 are summarized in Section 2. Since the study began, the monthly average wind speed at a height of 50 m has increased from 4.0 meters per second (m/s) in September to 4.9 m/s in December, while the average wind power density at 50 m increased from approximately 45 Watts per square meter (W/m^2) to 152 W/m^2) for the same time periods. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Data Analysis Summary

Wind data collected during the month of December 2007 are summarized below in Table 1 and Figures 1 and 2.

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1	98	29.9	201	8.6	3.8	11.5	5.1	84.1	0.25
2	98	29.9	291	9.2	4.1	11.8	5.3	92.2	0.23
3	131	39.9	201	9.9	4.4	12.7	5.7	114.0	0.21
4	131	39.9	291	9.9	4.4	12.7	5.7	113.1	0.21
5	164	50.0	201	11.1	4.9	14.0	6.2	151.9	0.18
6	164	50.0	291	10.9	4.9	14.0	6.2	151.8	0.19

Shear Exp	Channels	Exponent from Avg of Wind Shear Column	Exponent from Average Wind Speed
Exp1	1 to 3	0.7119	0.5019
Exp2	3 to 5	0.5217	0.4800
Exp3	2 to 4	0.2230	0.2454
Exp4	4 to 6	0.3377	0.4214

Figure 1: Daily Average Wind Speeds for December 2007.

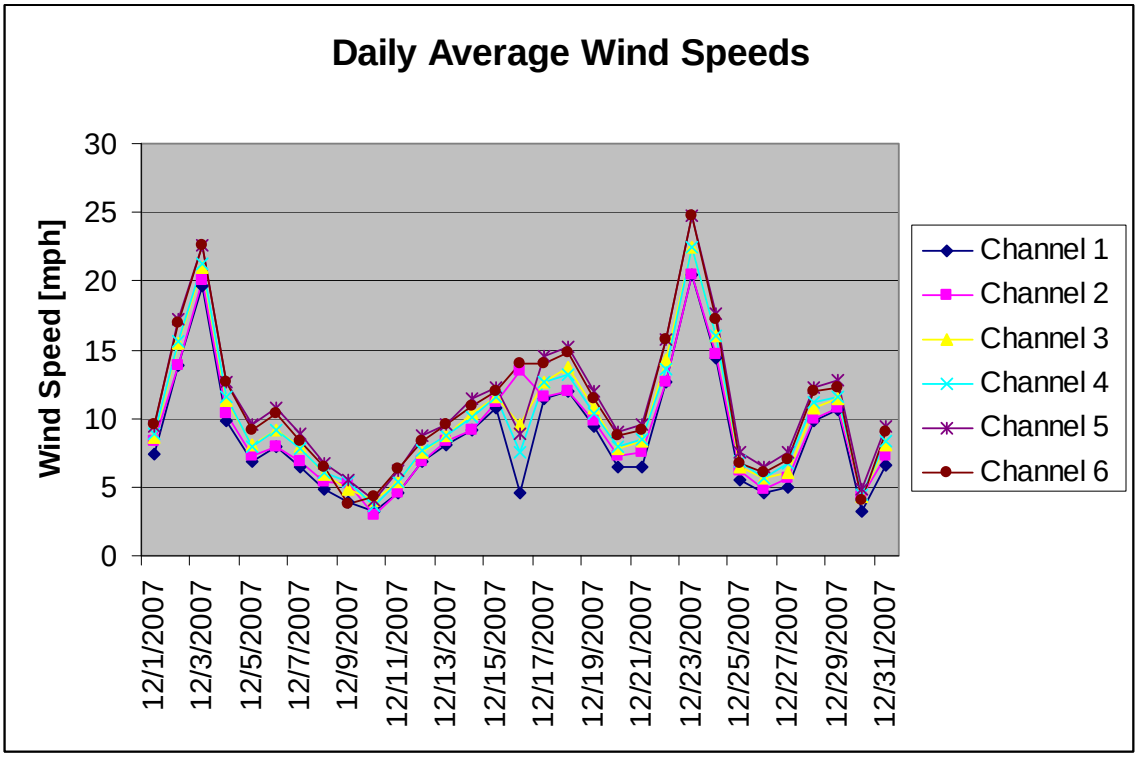
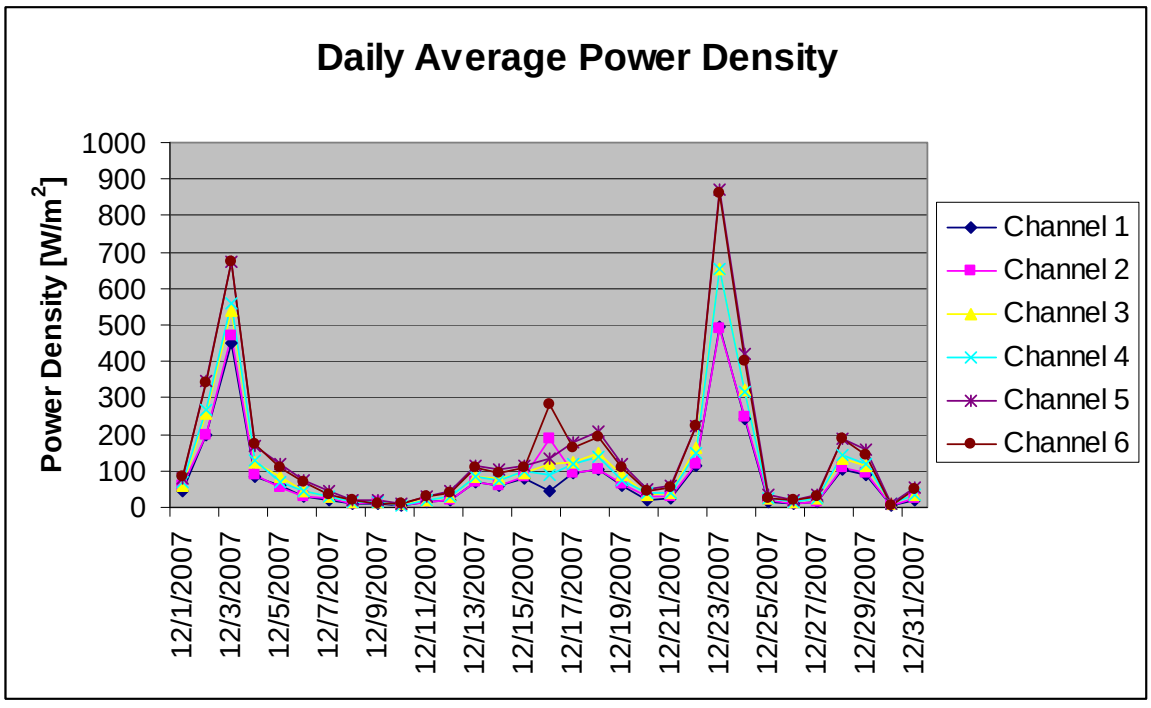


Figure 2: Daily Average Wind Power Density for December 2007.



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Prevailing Wind Direction:	202.5^{o} (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
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Logger Lock Combination: N/A

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FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

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Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
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2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
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9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.

NASA Plum Brook Station
Wind Assessment Study
January 2008 Monthly Summary Report

Prepared by:

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Following installation, no problems have been encountered thus far in acquiring the data with the exception of an icing event on December 16, 2007. Preliminary results for the month of January 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Since the study began in August, the monthly average wind speed continues to increase into the winter months, with the exception of December which faired slightly less than November and January. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of January are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
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2	98	29.9	291	11.9	5.3	13.8	6.2	146.9	0.23
3	131	39.9	201	12.9	5.7	14.8	6.6	182.6	0.21
4	131	39.9	291	12.9	5.8	14.9	6.7	185.1	0.21
5	164	50.0	201	14.4	6.4	16.4	7.3	247.0	0.18
6	164	50.0	291	14.1	6.3	16.2	7.3	238.0	0.19
Shear Exp	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.4129	0.3244						
Exp2	3 to 5	0.5411	0.4977						
Exp3	2 to 4	0.3242	0.2927						
Exp4	4 to 6	0.3706	0.3875						

Figure 1: Daily Average Wind Speeds for January 2008

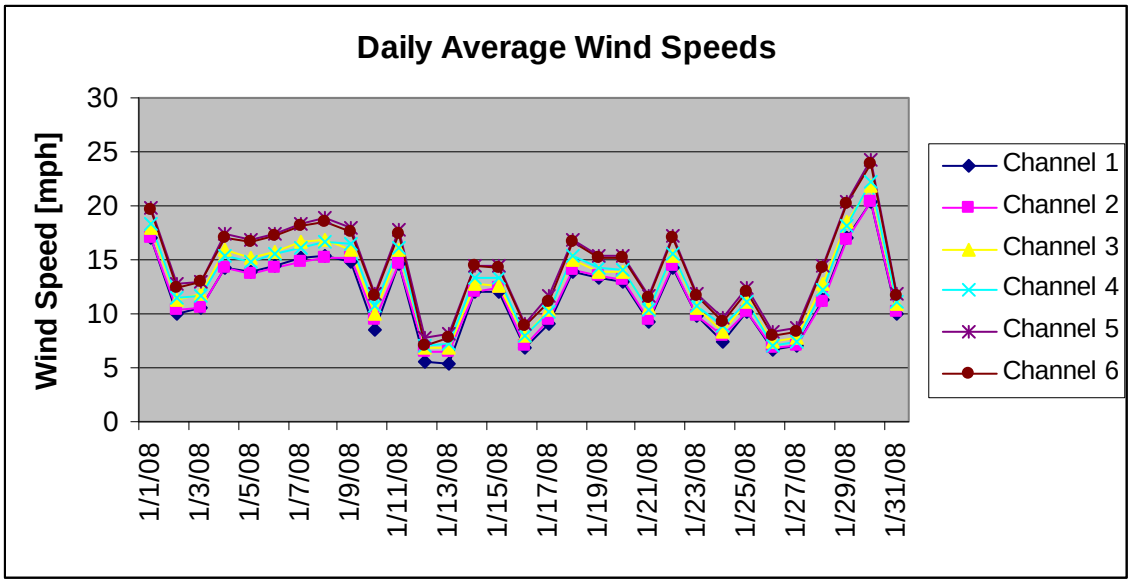
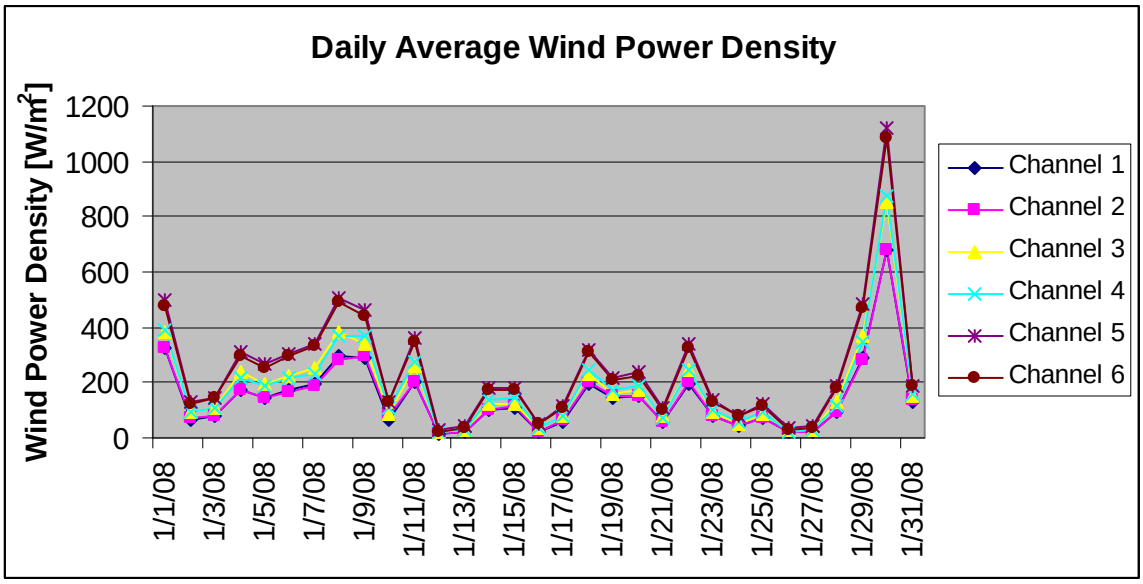


Figure 2: Daily Average Wind Power Density for January 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the five study to date.

Figure 3: Monthly Average Wind Speeds

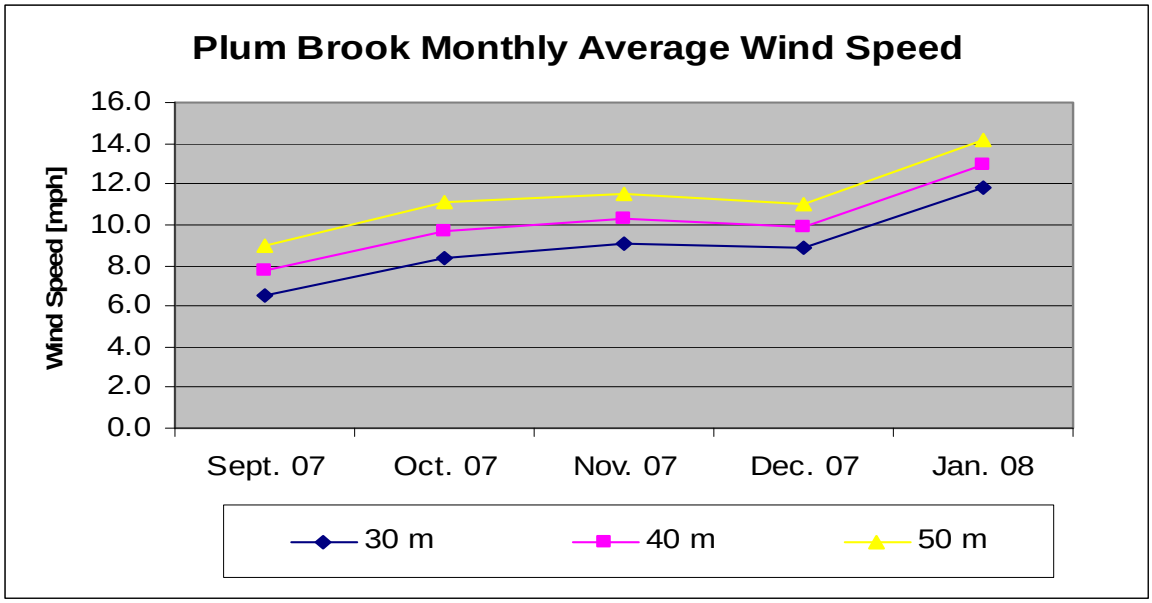
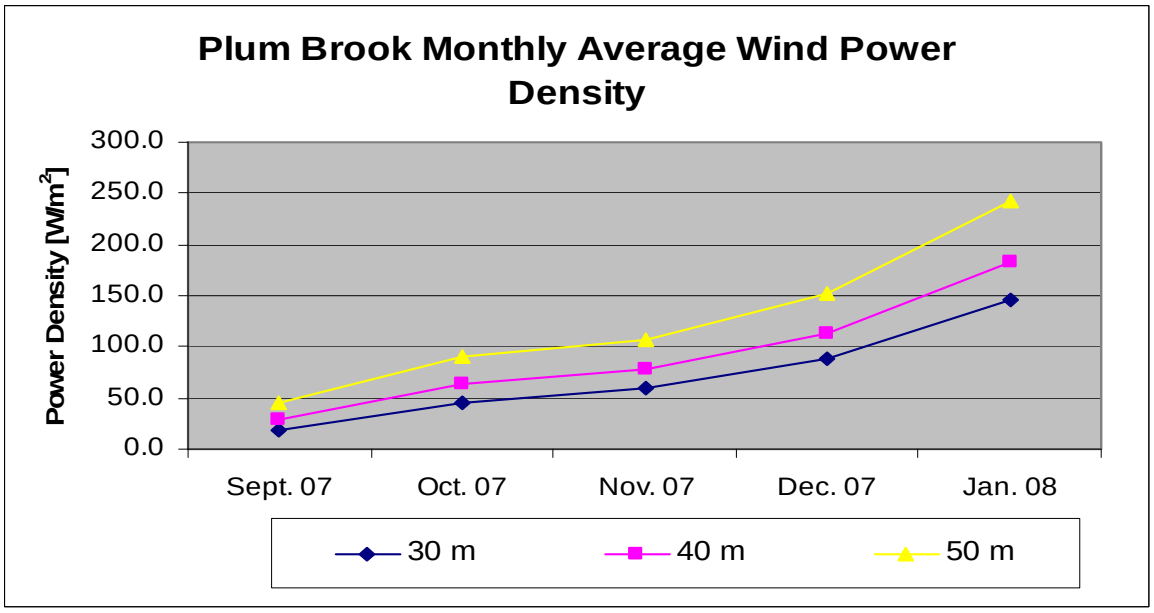


Figure 4: Monthly Average Wind Power Density



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Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.

NASA Plum Brook Station
Wind Assessment Study
February 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Data Analysis Technician
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

On August 21 and 22, 2007, a 50 meter (m) meteorological tower was installed at the NASA Plum Brook Station (PBS) located near Sandusky, Ohio. The tower is the culmination of several years of planning by members of NASA and Green Energy Ohio (GEO). NASA PBS became the 9th site in the state of Ohio for inclusion in GEO's public Ohio Wind Resource Database.

The goals of the wind monitoring study are to determine if it is feasible to erect a wind turbine at PBS, and if so, the corresponding power output that could be obtained. According to Mr. Henry Wroblewski, Glenn Research Center Energy Program Manager, NASA is working in response to the Energy Policy Act of 2005 to reach the goal of achieving 3% of its electricity needs from renewable energy sources. This federal requirement will increase to 5% in 2009 and 7.5% in 2012. NASA would also like to reduce its electricity costs.

Following installation, no problems have been encountered thus far in acquiring the data with the exception of one icing event in December, which lasted less than 24 hours, and three icing events in February, one of which lasted almost 48 hours (see incident log in Appendix A). Preliminary results for the month of February 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Since the study began in August, the monthly average wind speed and power density has continued to increase, with the exception of a decrease in these values from January to February 2008. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of February are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	9.2	4.1	12.1	5.4	99.8	0.23
2	98	29.9	291	9.3	4.2	12.1	5.4	100.4	0.22
3	131	39.9	201	10.2	4.6	13.0	5.8	122.6	0.19
4	131	39.9	291	10.2	4.6	13.0	5.8	122.9	0.19
5	164	50.0	201	11.4	5.1	14.3	6.4	165.0	0.17
6	164	50.0	291	11.1	5.0	14.1	6.3	156.9	0.18
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.4682	0.3540						
Exp2	3 to 5	0.4907	0.4906						
Exp3	2 to 4	0.3388	0.3059						
Exp4	4 to 6	0.3561	0.3901						

Figure 1: Daily Average Wind Speeds for February 2008

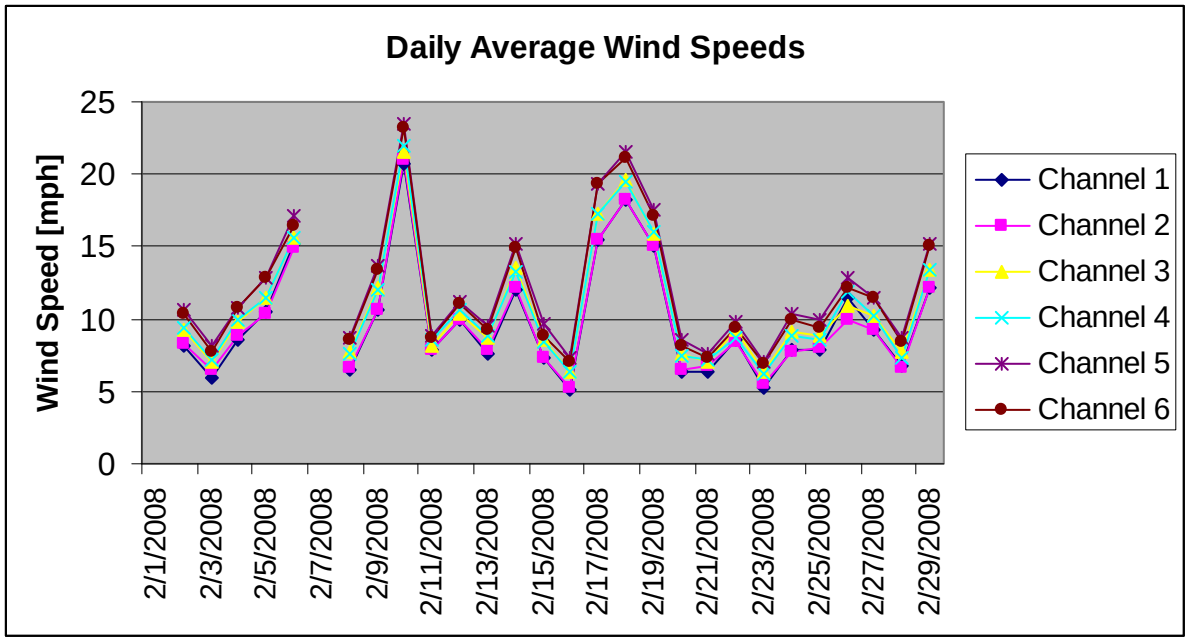
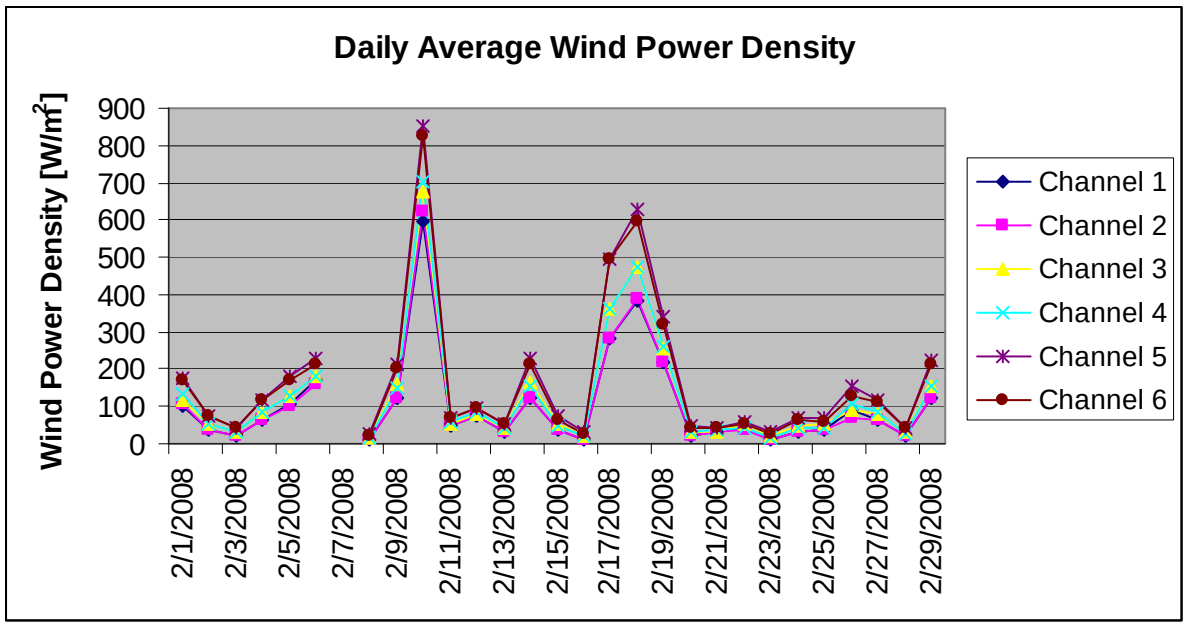


Figure 2: Daily Average Wind Power Density for February 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date.

Figure 3: Monthly Average Wind Speeds

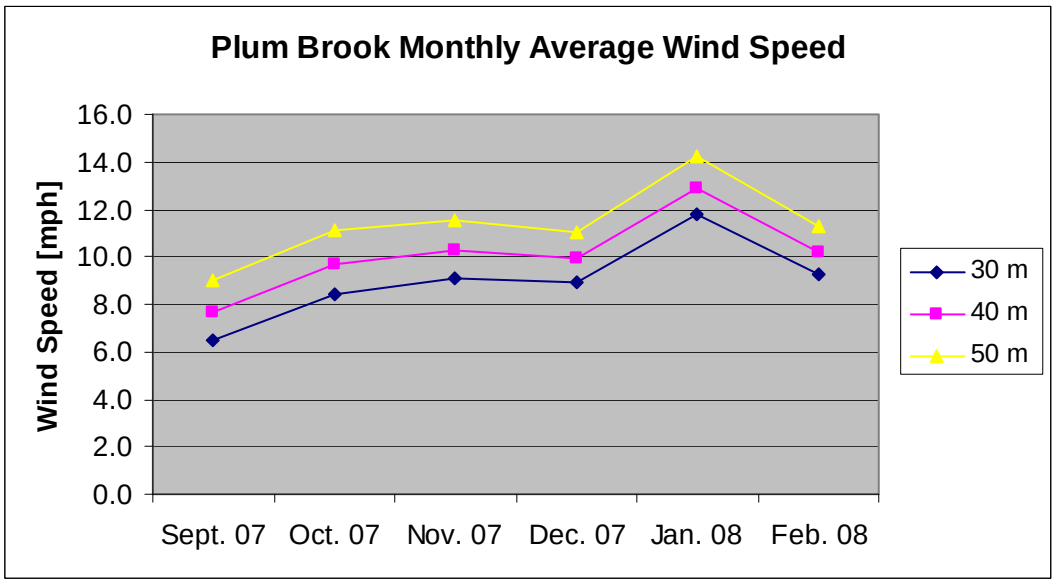
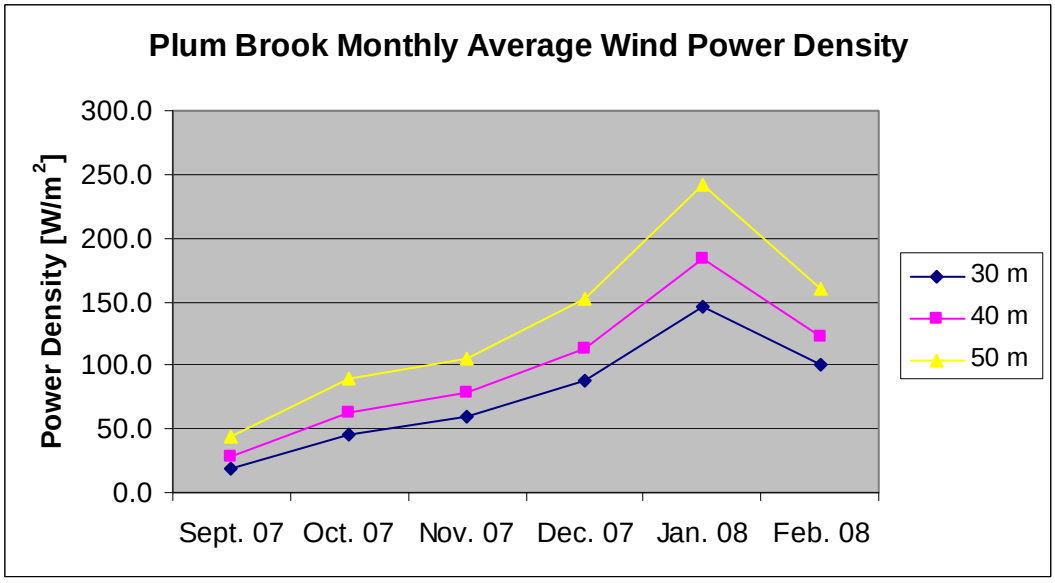


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name:	NASA Plum Brook
Installation Date:	August 21 and 22, 2007
Tower Owner:	Green Energy Ohio
Site Location (description):	Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates):	N 41.3716 ^{o} ; W 82.6503^{o}
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5^{o} (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
	Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell

Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.

NASA Plum Brook Station
Wind Assessment Study
March 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Data Analysis Technician
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data acquisition issues for March include an icing event from the 4th through the 6th which affected all channels periodically (see incident log in Appendix A). Also, channel 2 has failed since March 12th; resulting in a loss data (this issue is currently being investigated). Preliminary results for the month of March 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of March are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	10.2	4.5	12.5	5.6	109.2	0.21
2	98	29.9	291	4.5	2.0	9.4	4.2	45.6	0.08
3	131	39.9	201	10.6	4.7	13.2	5.9	128.6	0.19
4	131	39.9	291	10.7	4.8	13.1	5.8	123.9	0.19
5	164	50.0	201	12.1	5.4	14.7	6.6	175.7	0.17
6	164	50.0	291	11.1	5.0	14.0	6.3	151.8	0.17
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	-0.0352	0.1376						
Exp2	3 to 5	0.8174	0.5926						
Exp3	2 to 4	5.1709	2.9994						
Exp4	4 to 6	-0.1904	0.1743						

Figure 1: Daily Average Wind Speeds for March 2008

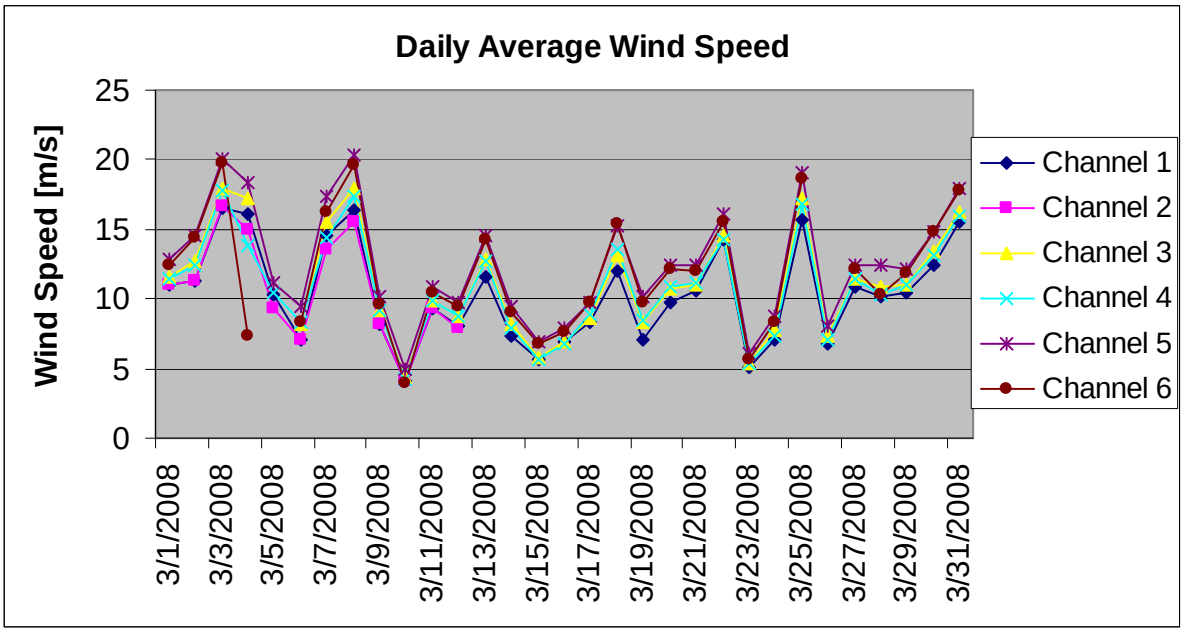
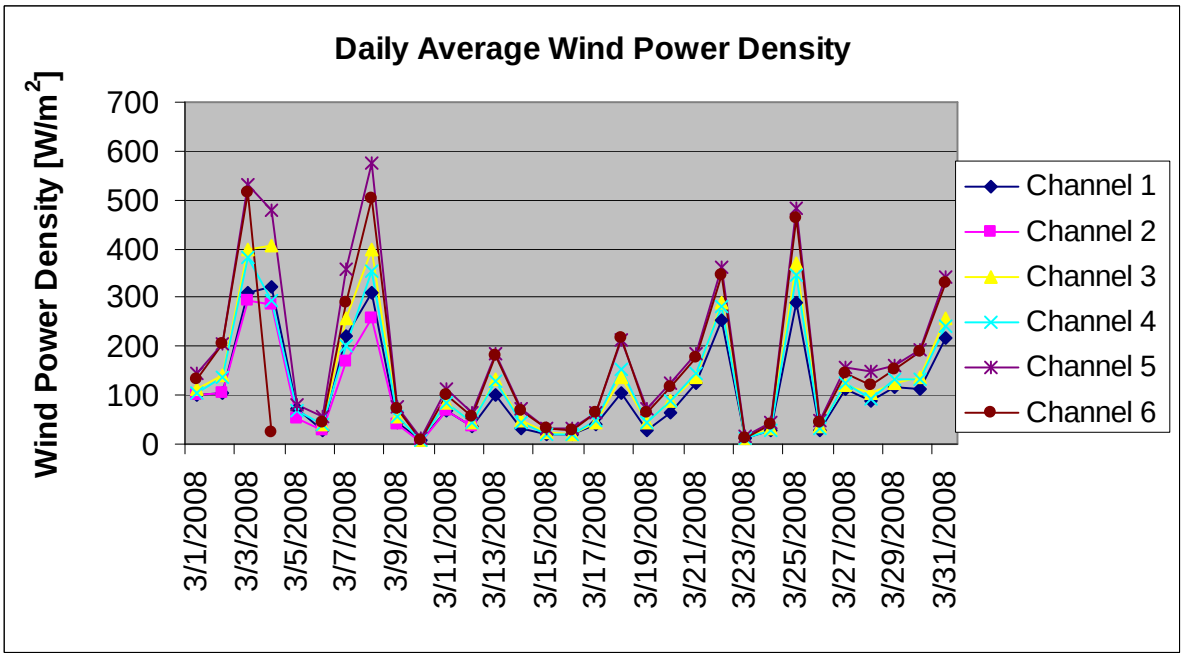


Figure 2: Daily Average Wind Power Density for March 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in August, the monthly average wind speed and power density generally increased during the winter months and are now decreasing as spring approaches.

Figure 3: Monthly Average Wind Speeds

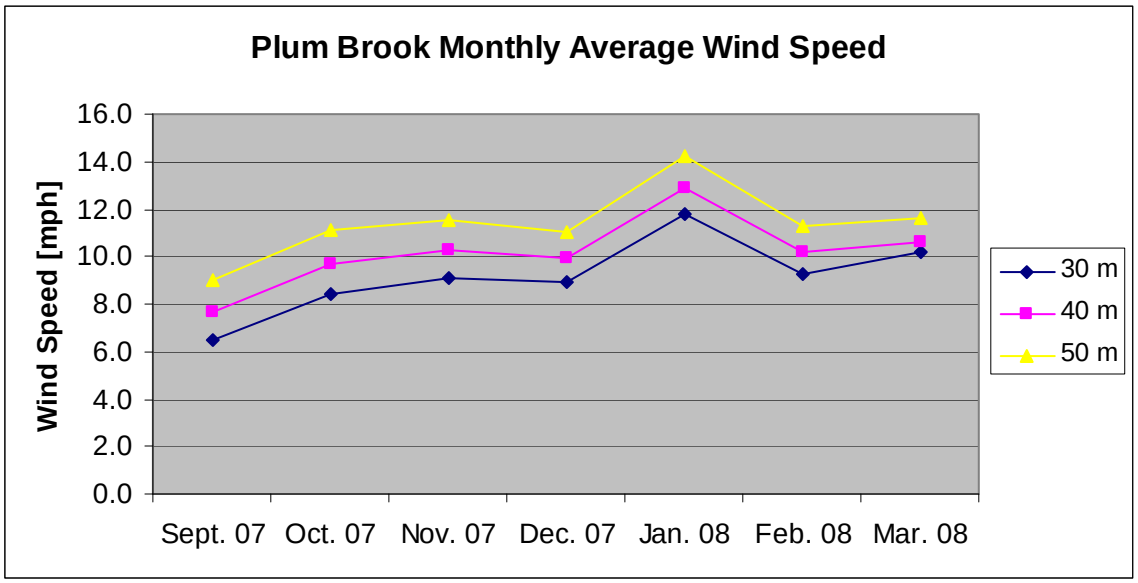
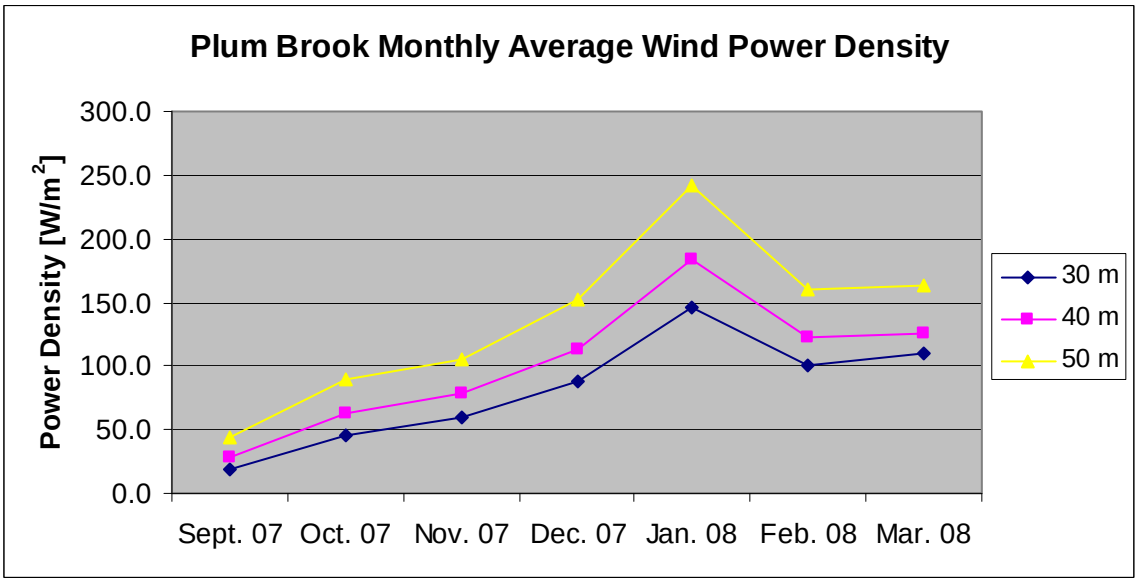


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name: NASA Plum Brook
Installation Date: August 21 and 22, 2007
Tower Owner: Green Energy Ohio
Site Location (description): Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates): N 41.3716 ^{o} ; W 82.6503^{o}
Ground Elevation: 696 ft
Prevailing Wind Direction: 202.5^{o} (from Ohio Wind Explorer)
Site Sponsor Contacts: Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell
Logger Lock Combination: N/A

TOWER

FCC Tower Registration: None - (50 meter temporary met tower)
Height of structure: 164 ft
Nominal Boom Heights: 30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, S/N: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.

3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th, and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.

3/12/2008: Loss of data from channel 2 starting at 11:00 p.m. and continuing through the month.

NASA Plum Brook Station
Wind Assessment Study
April 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data acquisition issues for April include the loss of data from channel 2 beginning March 12th and continuing through the month of April. Data was also lost from channel 10 (temperature sensor) beginning April 21st and continuing through the month of April. When a site visit was performed on May 1st, the wiring for channels 2 and 10 were found to be damaged from what we suspect to be wildlife. The wires were repaired May 1st. Since that date, channel 2 (one of two 30 m height anemometers) and the temperature sensor have been operating correctly. Preliminary results for the month of April 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of April are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	9.3	4.2	11.2	5.0	84.3	0.22
2	98	29.9	291	0.8	0.4	0.8	0.4	0.0	0.00
3	131	39.9	201	10.2	4.6	12.0	5.4	104.0	0.20
4	131	39.9	291	10.1	4.5	11.9	5.3	101.5	0.20
5	164	50.0	201	11.4	5.1	13.2	5.9	138.9	0.18
6	164	50.0	291	11.1	5.0	13.0	5.8	132.3	0.18
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.3676	0.3141						
Exp2	3 to 5	0.5278	0.4880						
Exp3	2 to 4	N/A	N/A						
Exp4	4 to 6	0.4848	0.4531						

Figure 1: Daily Average Wind Speeds for April 2008

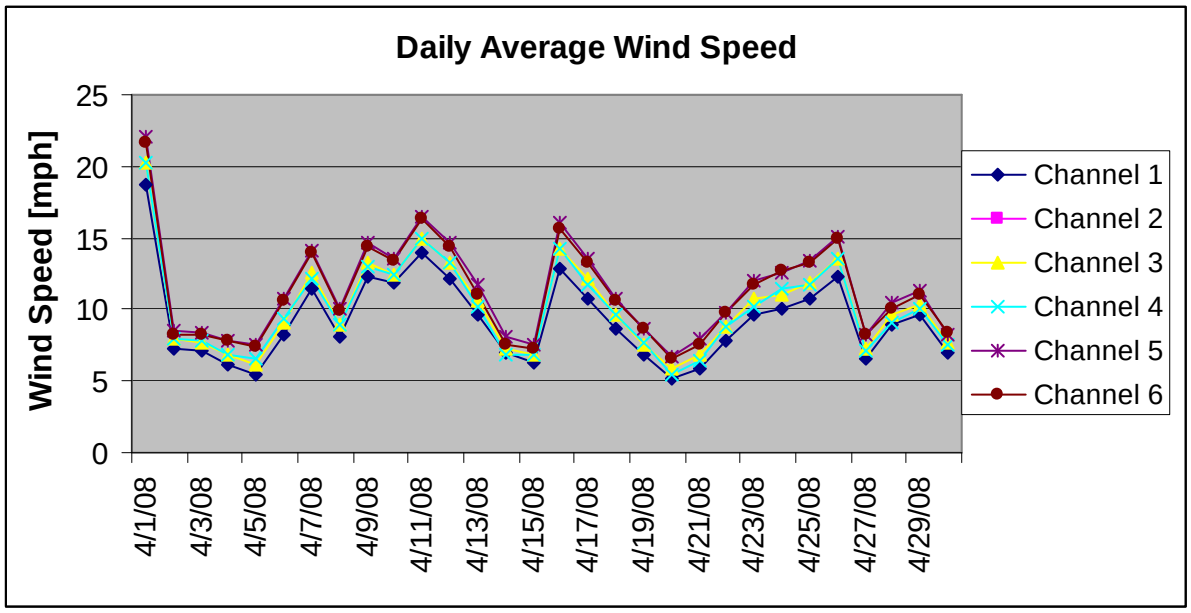
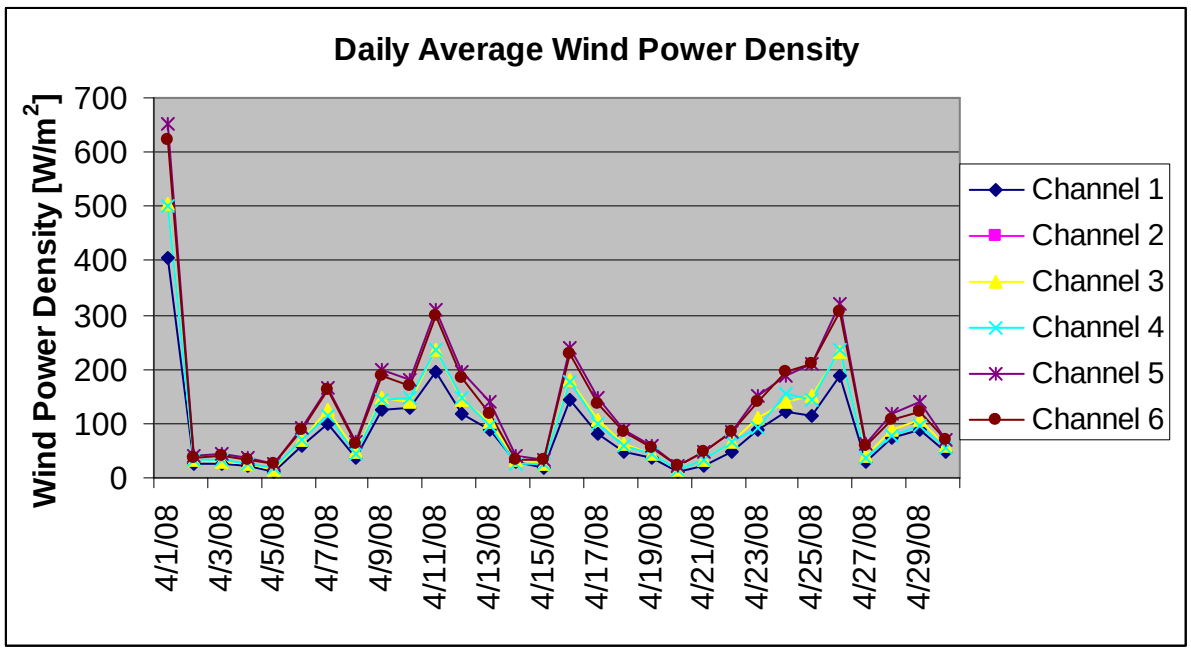


Figure 2: Daily Average Wind Power Density for April 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in August, the monthly average wind speed and power density have continued to increase into the winter months and are now decreasing as spring approaches, with the exception of December and February in which measured wind speed values were lower than expected.

Figure 3: Monthly Average Wind Speeds

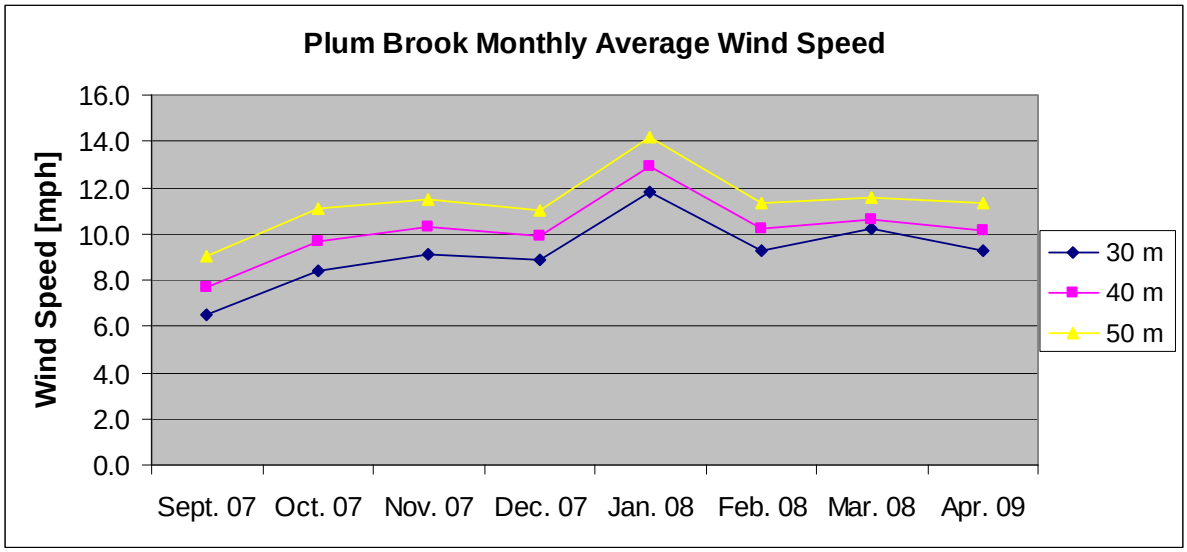
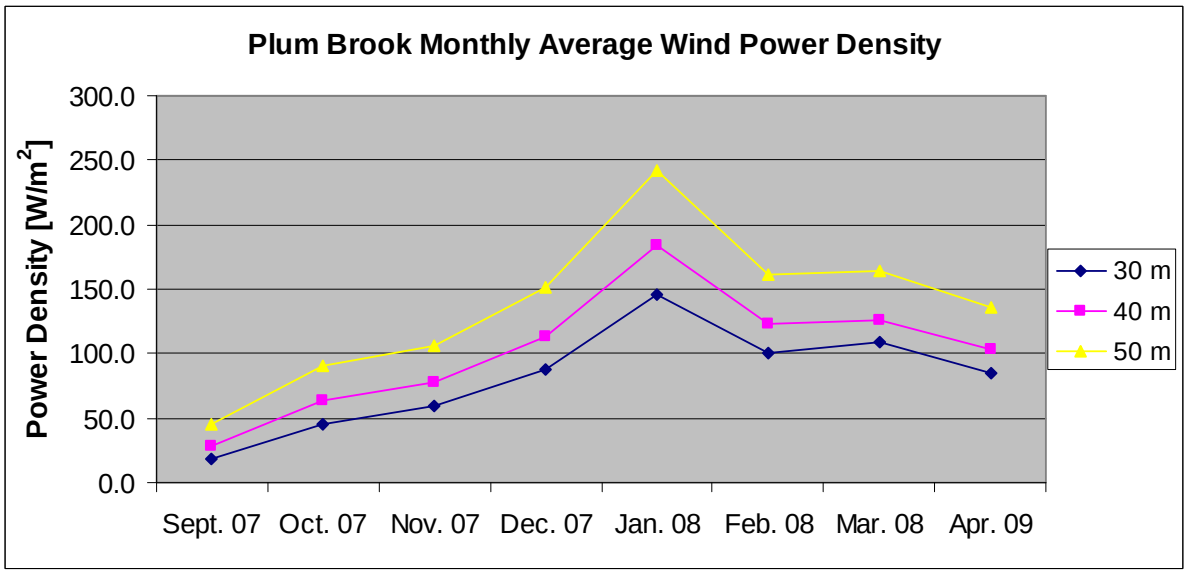


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name: NASA Plum Brook
Installation Date: August 21 and 22, 2007
Tower Owner: Green Energy Ohio
Site Location (description): Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates): N 41.3716°; W 82.6503°
Ground Elevation: 696 ft
Prevailing Wind Direction: 202.5^{o} (from Ohio Wind Explorer)
Site Sponsor Contacts: Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell
Logger Lock Combination: N/A

TOWER

FCC Tower Registration: None - (50 meter temporary met tower)
Height of structure: 164 ft
Nominal Boom Heights: 30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.

3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th, and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.

3/12/2008: Loss of data from channel 2 beginning at 11:00 p.m. and continuing through 5/1/2008 at 12:10 p.m. when a damaged wire was repaired.

4/21/2008: Loss of data from channel 10 beginning at 10:30 p.m. and continuing through 5/1/2008 at 12:50 p.m. when a damaged wire was repaired and changed to the channel 9 port.

NASA Plum Brook Station
Wind Assessment Study
May 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data acquisition issues for the month of May include the loss of data from channel 2 beginning March 12th and continuing through the afternoon of May 1st. Data was also lost from channel 10 (temperature sensor) beginning April 21st and continuing through the afternoon of May 1st. When a site visit was performed on May 1st the wiring for channels 2 and 10 were found to be damaged from what we suspect to be wildlife. The wires were repaired May 1st and channel 2 (one of two 30 m height anemometers) and the temperature sensor have been operating correctly since.

Preliminary results for the month of May 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of May are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	9.0	4.0	10.7	4.8	65.2	0.25
2	98	29.9	291	8.9	4.0	10.6	4.8	64.0	0.24
3	131	39.9	201	10.1	4.5	11.8	5.3	86.1	0.22
4	131	39.9	291	9.9	4.4	11.6	5.2	82.4	0.22
5	164	50.0	201	11.2	5.0	12.9	5.8	115.0	0.20
6	164	50.0	291	11.0	4.9	12.8	5.7	110.8	0.20
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.4668	0.3923						
Exp2	3 to 5	0.4618	0.4584						
Exp3	2 to 4	0.4771	0.3649						
Exp4	4 to 6	0.5288	0.4956						

Figure 1: Daily Average Wind Speeds for May 2008

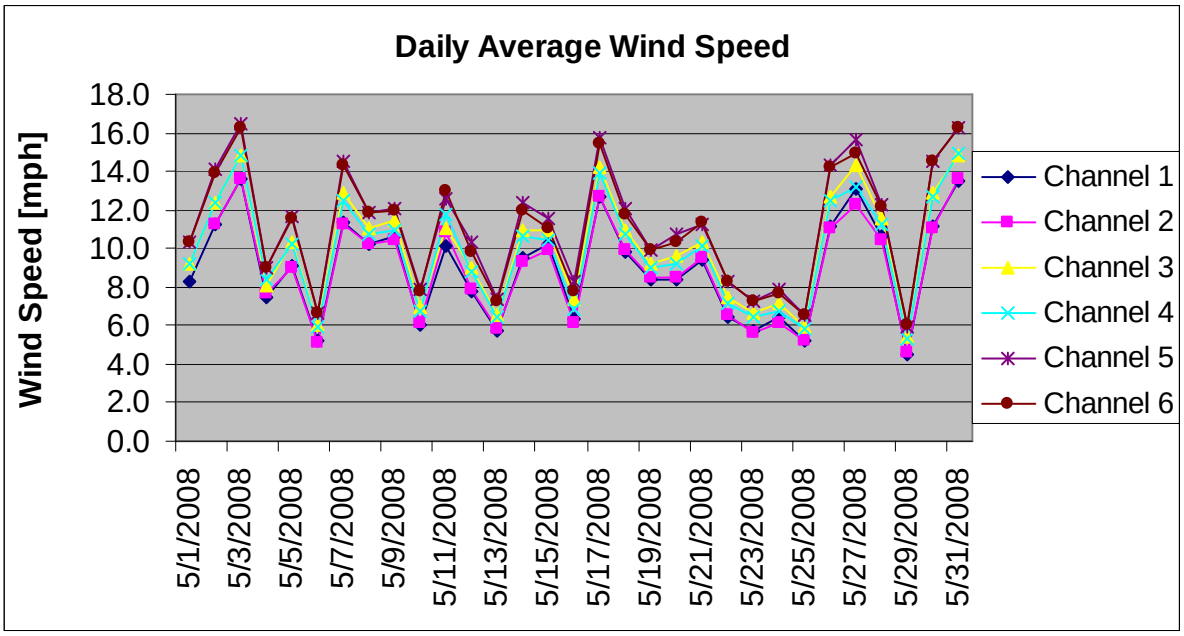
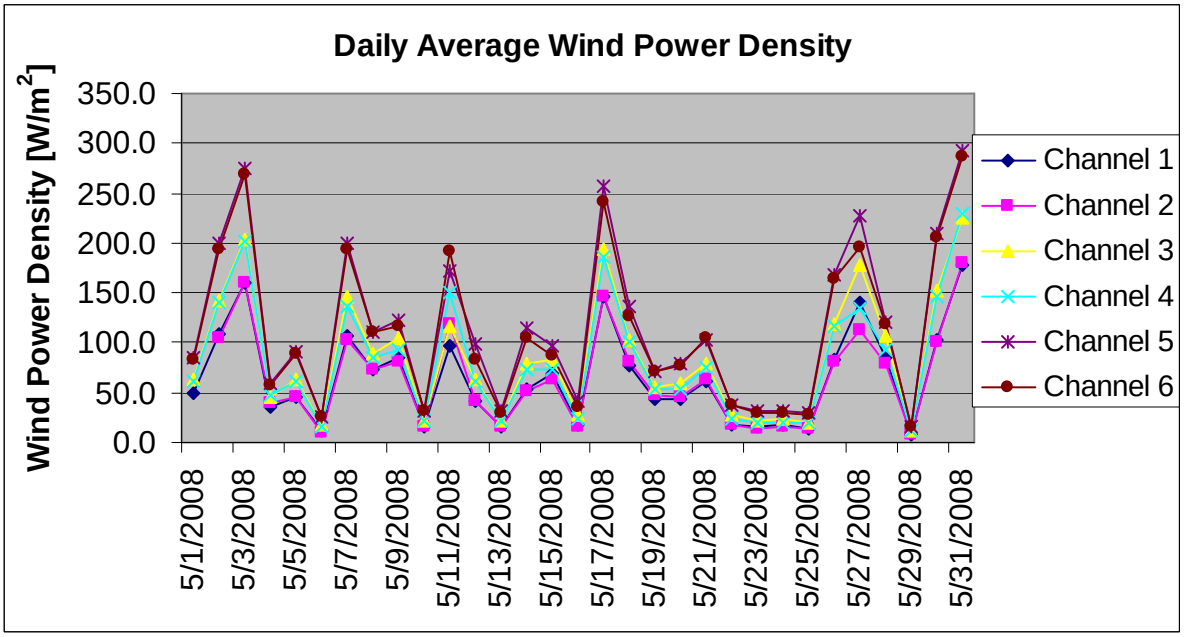


Figure 2: Daily Average Wind Power Density for May 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in August, the monthly average wind speed and power density have continued to increase into the winter months and are now decreasing through spring, with the exception of December and February in which measured wind speed values were lower than expected.

Figure 3: Monthly Average Wind Speeds

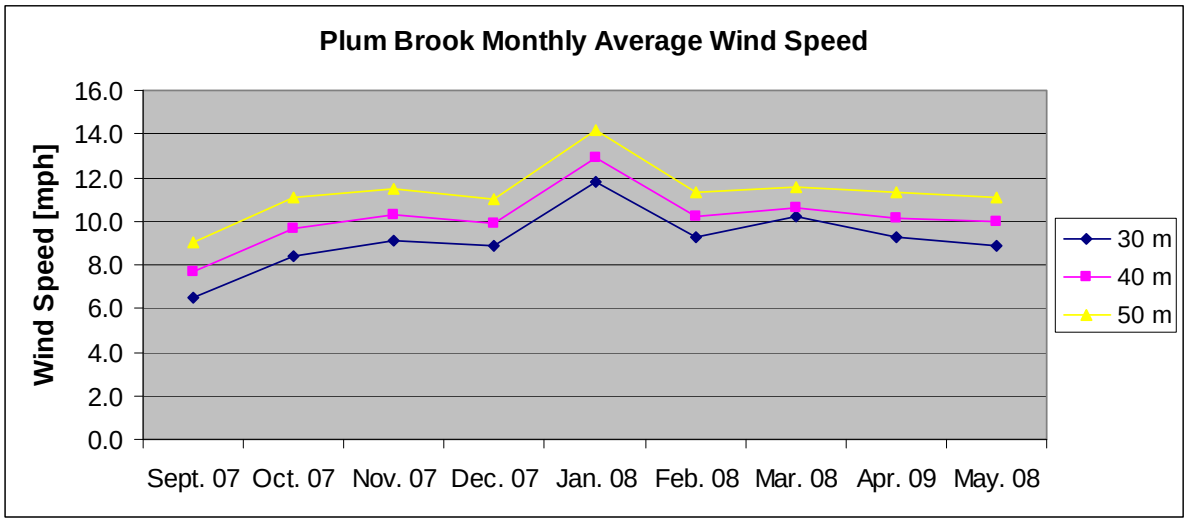
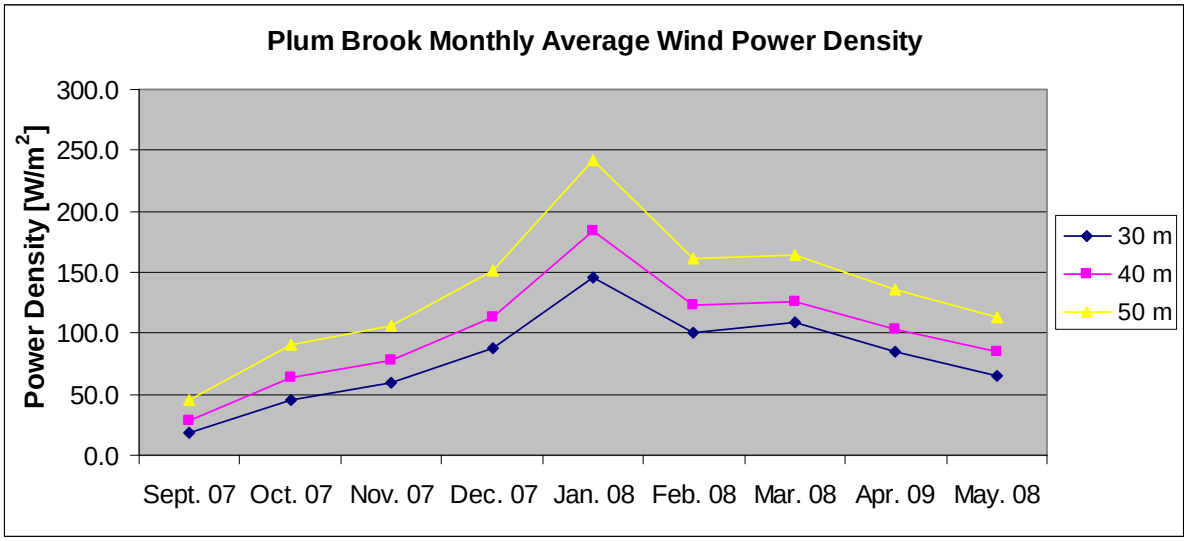


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name:	NASA Plum Brook
Installation Date:	August 21 and 22, 2007
Tower Owner:	Green Energy Ohio
Site Location (description):	Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates):	N 41.3716°; W 82.6503°
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
	Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell

Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	S/N	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES: tower orientation was 221 degrees on the ground

INCIDENT LOG:

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.
2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.
2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.
2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.
3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th, and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.
3/12/2008: Loss of data from channel 2 beginning at 11:00 p.m. and continuing through 5/1/2008 at 12:10 p.m. when a damaged wire was repaired.
4/21/2008: Loss of data from channel 10 beginning at 10:30 p.m. and continuing through 5/1/2008 at 12:50 p.m. when a damaged wire was repaired and changed to the channel 9 port.

NASA Plum Brook Station
Wind Assessment Study
June 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data acquisition issues for the month of June include the loss of data from channel 6 beginning the evening of June 7th and continuing through the end of the month. Data was also lost from channels 1 through 9 beginning the evening of June 21st and continuing through the morning of June 23rd, at which time channels 1 through 4 and 7 through 9 were recovered. The failure of channels 5 and 6 were due to damaged wires as a result of apparent wildlife impact. The failure of the remaining channels on the period of June 21st through June 23rd was due to loosened connections as a result of apparent wildlife interference close to the data logger (i.e., the wiring panel had been pulled from the data logger). The connections were repaired on the morning of the 23rd by site sponsor Rosemary Geisser (excluding channels 5 and 6).

Preliminary results for the month of June 2008, including an extrapolation of data for the 50 m height, are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of June are summarized below in Table 1 and Figures 1 and 2. Values listed in Table 1 for channel 5 are averaged over the period of June 1st through 21st when channel 5 was operational. Channel 5 was *not* operational from June 21st through the end of the month; therefore the values shown in the table are slightly unrepresentative descriptors for the entire month. Data for channel 6 were lost from June 7th through the end of the month. Therefore, values listed in Table 1 for channel 6 are average values of a combined monthly data set using channel 5 data for 6/1 - 6/21, and extrapolated data for the dates of 6/23 - 6/30. Due to a complete loss of all data for the dates of 6/21 - 6/23 an extrapolation could not be performed for this time period. The extrapolation was performed using the equation for wind shear (change in wind speed with height):

$$V = V_0\left(\frac{z}{z_0}\right)^{\alpha}$$

Here *V* is the wind velocity and z is the height. The subscript 0 indicates a reference height. The coefficient α is the wind shear exponent. The calculations were made using wind speed values measured at the 131 ft height (channels 3 and 4) and wind shear values calculated between the 98 and 131 ft level anemometers (channels 1 and 3 or channels 2 and 4). The extrapolation was also performed for the dates that channel 5 was operational (6/1-6/21) in order to compare the calculated wind speed values with the actual (channel 5) wind speed values. A percent error from the comparison was found to be 3.0%.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	7.9	3.5	9.2	4.1	39.7	0.27
2	98	29.9	291	8.0	3.6	9.2	4.1	40.3	0.26
3	131	39.9	201	9.2	4.1	10.5	4.7	59.9	0.23
4	131	39.9	291	9.0	4.0	10.3	4.6	56.1	0.23
5 (6/1-6/21)	164	50.0	201	10.8	4.8	12.2	5.4	92.6	0.20
6 (Channel 5 data from 6/1-6/21, Extrapolated data from 6/21-6/30	164	50.0	291	10.5	4.7	11.8	5.3	95.5	0.15

Shear Exponent	Channels	Exponent from Average of Wind Shear Column	Exponent from Average Wind Speed
Exp1	1 to 3	0.6027	0.5562
Exp2	3 to 5	0.5564	0.6906
Exp3	2 to 4	0.4436	0.4297
Exp4	4 to 6	0.4071	0.6604

Figure 1: Daily Average Wind Speeds for June 2008

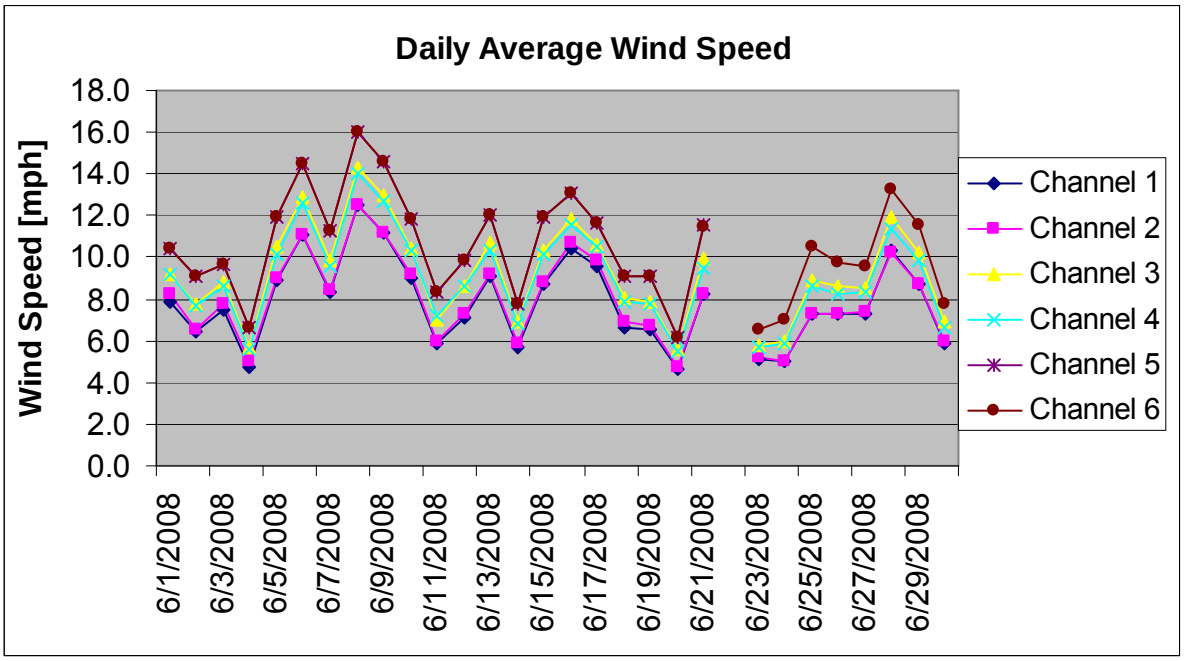
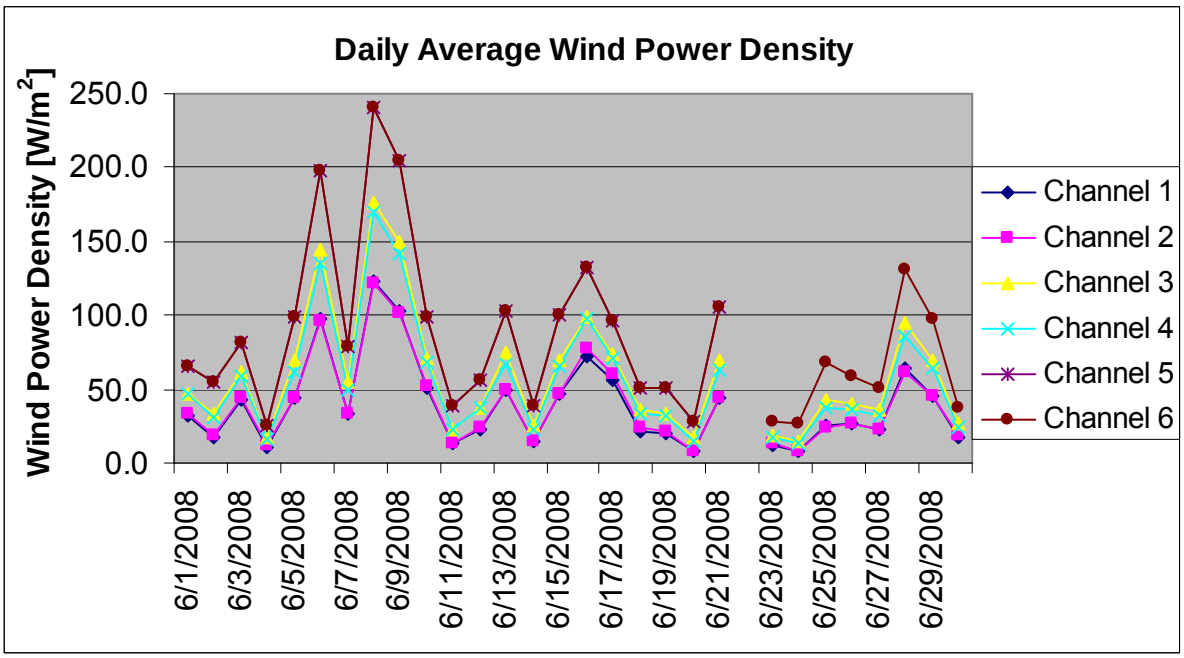


Figure 2: Daily Average Wind Power Density for June 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date (monthly averages from the modified channel 6 data set were used for the 50 m data for June). Since the study began in August, the monthly average wind speed and power density have continued to increase into the winter months and are now decreasing through the beginning of summer, with the exception of December and February in which measured wind speed values were lower than expected.

Figure 3: Monthly Average Wind Speeds

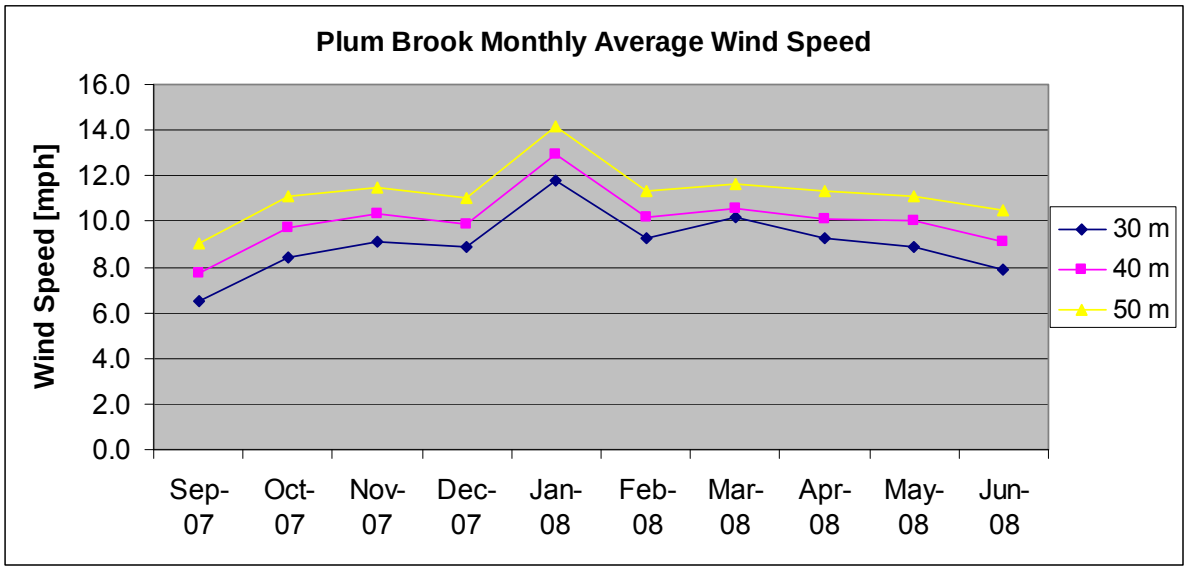
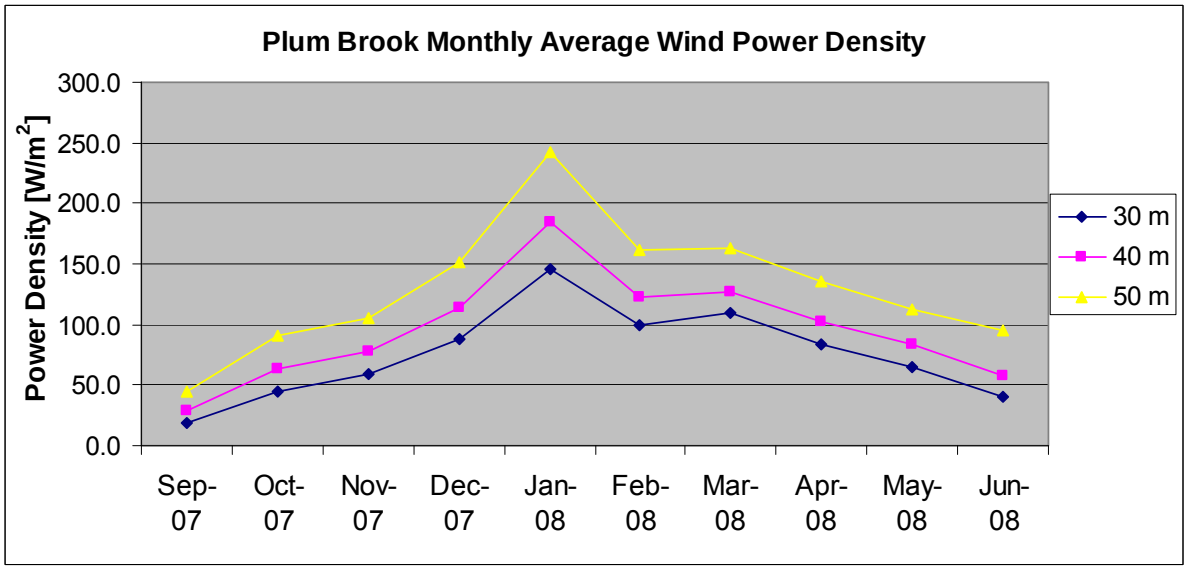


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name:	NASA Plum Brook Station
Installation Date:	August 21 and 22, 2007
Tower Owner:	Green Energy Ohio
Site Location (description):	Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates):	N 41.3716° ; W 82.6503°
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
	Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell

Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.

3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th, and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.

3/12/2008: Loss of data from channel 2 beginning at 11:00 p.m. and continuing through 5/1/2008 at 12:10 p.m. when a damaged wire was repaired.

4/21/2008: Loss of data from channel 10 beginning at 10:30 p.m. and continuing through 5/1/2008 at 12:50 p.m. when a damaged wire was repaired and changed to the channel 9 port.

6/7/2008: Loss of data from channel 6 beginning at 8:20 p.m., due to damage to wiring by wildlife, and continuing through 7/16/08 at approx. 11:30 a.m. when a severed cable was repaired.

6/21/2008: Loss of data from channels 1-9 beginning at 10:40 p.m., due to loosened connections as a result of interference from wildlife, and continuing through 6/23/2008 at 7:40 a.m. when cable was reattached to wiring panel by sight sponsor Rosemary Giesser. However, the wiring for channel 5 was damaged and could not be repaired at this time.

7/16/2008: Kemp Jaycox made the following repairs (approx. 11:30 a.m.):

1. Ch. 5 anemometer – cleaned, stripped and reattached this cable which had been pulled from the wiring panel on the logger box
2. Ch. 6 anemometer – cleaned, stripped and reattached this cable which had been severed in half
3. Switched temp. sensor and SCM card from Ch. 9 to Ch. 10
4. Ch. 7 & 8 vanes - cleaned, stripped and reattached these cables. They were frayed at their attachment point to the wiring panel.
5. Added new color ID tape to several cables.
6. Raised and tightened the spool containing the cables. This had been pulled down and several cables were unraveled by our friendly critter.
7. Applied 2” electrical tape around the spool which will hopefully prevent the critter from biting into any more cables until we can install a more permanent fix.
8. Added zip ties and other electrical tape to secure and tighten the cables and grounding wire in various locations.

NASA Plum Brook Station
Wind Assessment Study
July 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data acquisition issues for the month of July include the loss of data from channel 5 and 6 beginning in June and continuing to the morning of July 16th. The failure of channels 5 and 6 were due to damaged wires as a result of apparent wildlife impact. The wires were repaired on the morning of July 16th.

Preliminary results for the month of July 2008, including an extrapolation of data to a height of 50 m, are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of July are summarized below in Table 1 and Figures 1 and 2. Values listed in Table 1 for channel 5 are averaged over the period of July 16th through July 31st when channel 5 was operational. Channel 5 was *not* operational from July 1st through July 16th; therefore the values shown in the table are slightly unrepresentative descriptors for the entire month. Values listed in Table 1 for channel 6 (with the exception of the turbulent intensity value, which is an average for the dates of July 16th – July 31st) are an average of extrapolated data for the dates of July 1st through July 16th, and data collected by channel 6 from July 16th through July 31st. The extrapolation was performed using the equation for wind shear (change in wind speed with height):

$$V = V_0\left(\frac{z}{z_0}\right)^{\alpha}$$

Here *V* is the wind velocity and z is the height. The subscript 0 indicates a reference height. The coefficient α is the wind shear exponent. The calculations were made using wind speed values measured at the 131 ft height (channels 3 and 4) and wind shear values calculated between the 98 and 131 ft level anemometers (channels 1 and 3 or channels 2 and 4). The extrapolation was also performed for the dates that channel 5 and 6 were operational (7/16 - 7/31) in order to compare the calculated wind speed values with actual wind speed values recorded for each channel. Percent errors from the comparison were found to be 4.0% and 3.7%.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	6.8	3.0	7.8	3.5	24.1	0.26
2	98	29.9	291	6.9	3.1	7.8	3.5	24.4	0.25
3	131	39.9	201	8.1	3.6	9.0	4.0	37.4	0.22
4	131	39.9	291	7.9	3.5	8.7	3.9	34.6	0.21
5 (7/16-7/31)	164	50.0	201	8.9	4.0	9.6	4.3	46.2	0.19
6 (Extrapolated Data From 7/1-7/16, Ch 6 Data from 7/16-7/31)	164	50.0	291	9.3	4.1	10.2	4.6	54.9	0.19 (Averaged from 7/16-7/31)
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.6615	0.6054						
Exp2	3 to 5	0.5919	0.4297						
Exp3	2 to 4	0.5417	0.4935						
Exp4	4 to 6	0.6468	0.7007						

Figure 1: Daily Average Wind Speeds for July 2008

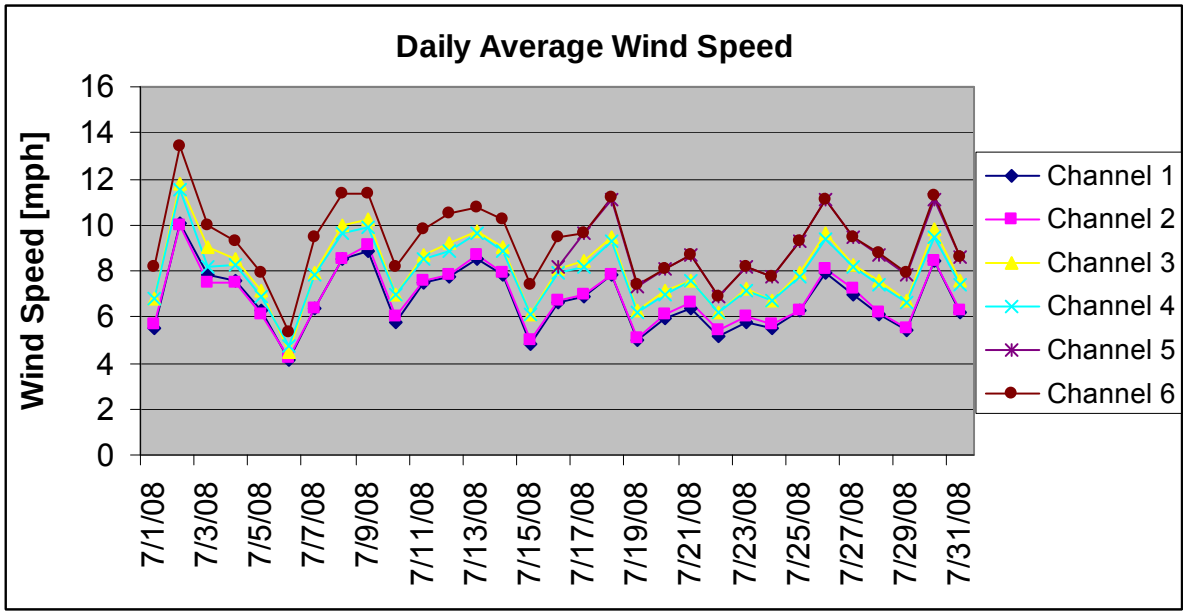
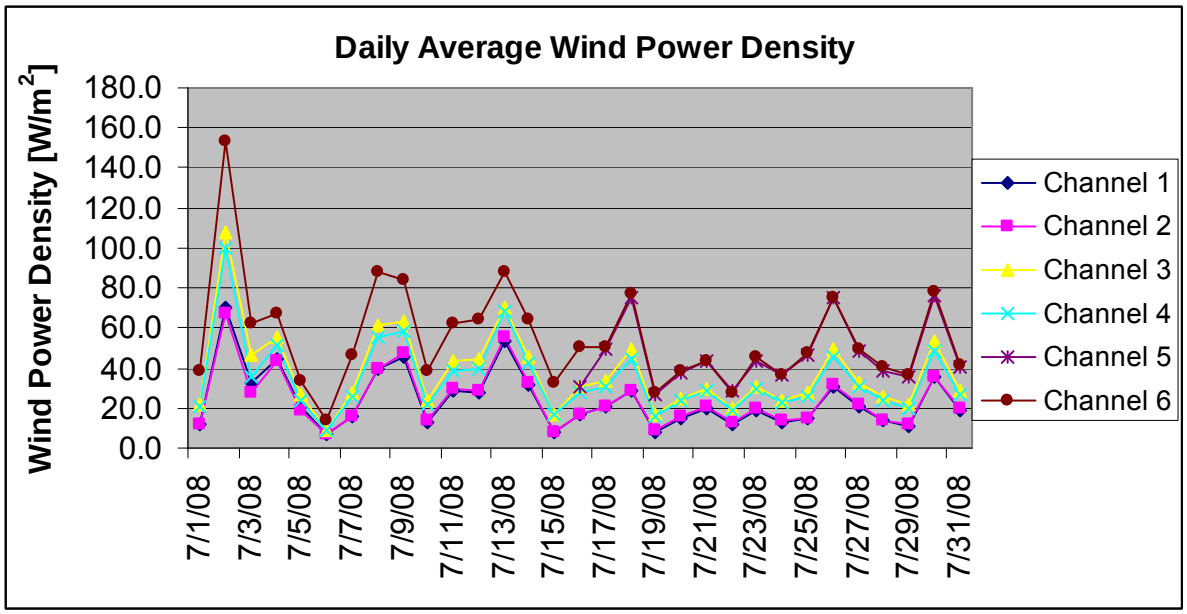


Figure 2: Daily Average Wind Power Density for July 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date, respectively (monthly averages from the modified channel 6 data set were used for the 50 m data for June and July). Since the study began in August, the monthly average wind speed and power density have continued to increase into the winter months and have decreased through the summer, with the exception of December and February in which measured wind speed values were lower than expected.

Figure 3: Monthly Average Wind Speeds

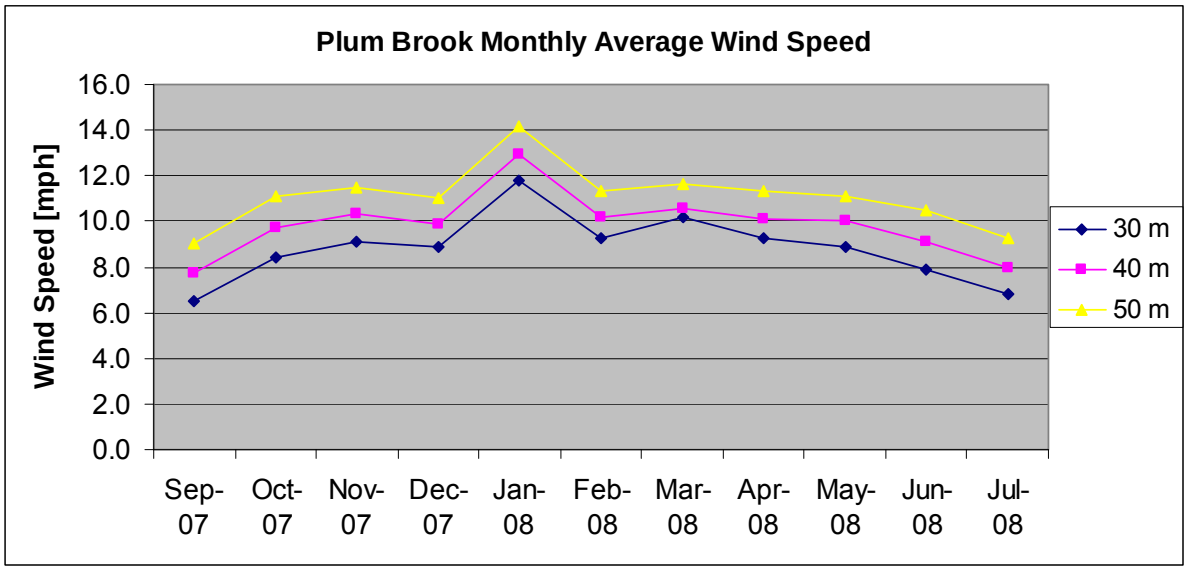
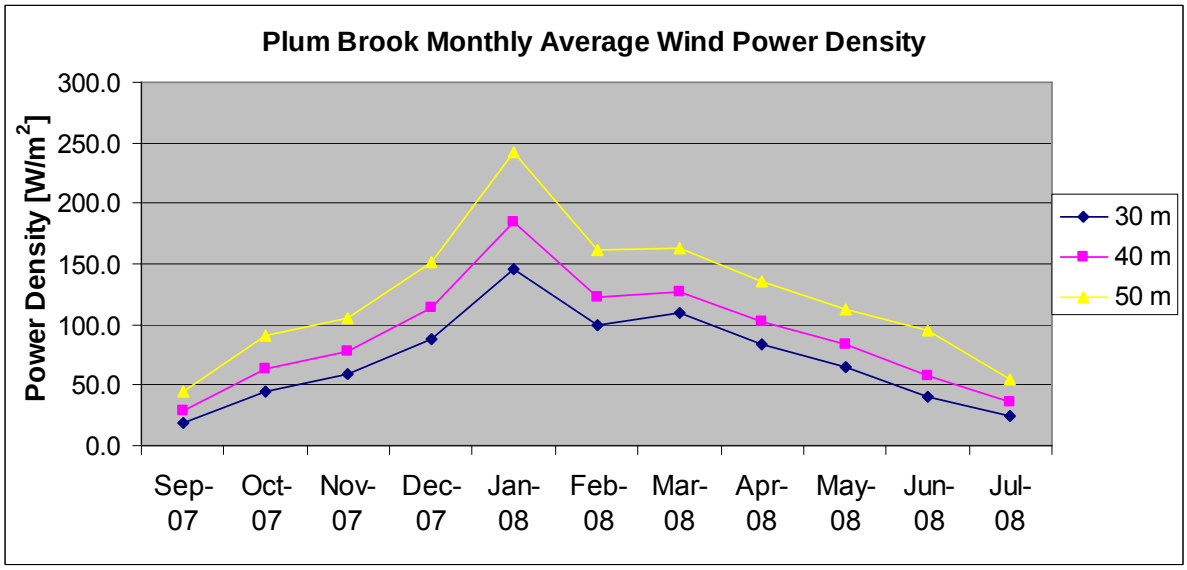


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name:	NASA Plum Brook Station
Installation Date:	August 21 and 22, 2007
Tower Owner:	Green Energy Ohio
Site Location (description):	Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates):	N 41.3716°; W 82.6503°
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
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Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
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4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
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9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however, channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

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3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.

3/12/2008: Loss of data from channel 2 beginning at 11:00 p.m. and continuing through 5/1/2008 at 12:10 p.m. when a damaged wire was repaired.

4/21/2008: Loss of data from channel 10 beginning at 10:30 p.m. and continuing through 5/1/2008 at 12:50 p.m. when a damaged wire was repaired and changed to the channel 9 port.

6/7/2008: Loss of data from channel 6 beginning at 8:20 p.m., due to damage to wiring by wildlife, and continuing through 7/16/08 at approx. 11:30 a.m. when a severed cable was repaired.

6/21/2008: Loss of data from channels 1-9 beginning at 10:40 p.m., due to loosened connections as a result of interference from wildlife, and continuing through 6/23/2008 at 7:40 a.m. when cable was reattached to wiring panel by sight sponsor Rosemary Giesser. However, the wiring for channel 5 was damaged and could not be repaired at this time.

7/16/2008: Kemp Jaycox made the following repairs (approx. 11:30 a.m.):

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5. Added new color ID tape to several cables.
6. Raised and tightened spool containing the cables. This had been pulled down and several cables were unraveled by our friendly critter.
7. Applied 2” electrical tape around the spool which will hopefully prevent the critter from biting into any more cables until we can install a more permanent fix.
8. Added zip ties and other electrical tape to secure and tighten the cables and grounding wire in various locations.

NASA Plum Brook Station
Wind Assessment Study
August 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. For the month of August data recovery was 100%.

Preliminary results for the month of August 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of August are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	7.0	3.1	8.3	3.7	29.9	0.26
2	98	29.9	291	7.0	3.1	8.3	3.7	29.3	0.25
3	131	39.9	201	8.2	3.7	9.4	4.2	42.9	0.20
4	131	39.9	291	8.0	3.6	9.2	4.1	40.1	0.21
5	164	50.0	201	9.1	4.1	10.3	4.6	56.8	0.19
6	164	50.0	291	9.2	4.1	10.4	4.6	58.2	0.18
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.6965	0.5677						
Exp2	3 to 5	0.4662	0.4681						
Exp3	2 to 4	0.5453	0.4705						
Exp4	4 to 6	0.6219	0.6082						

Figure 1: Daily Average Wind Speeds for August 2008

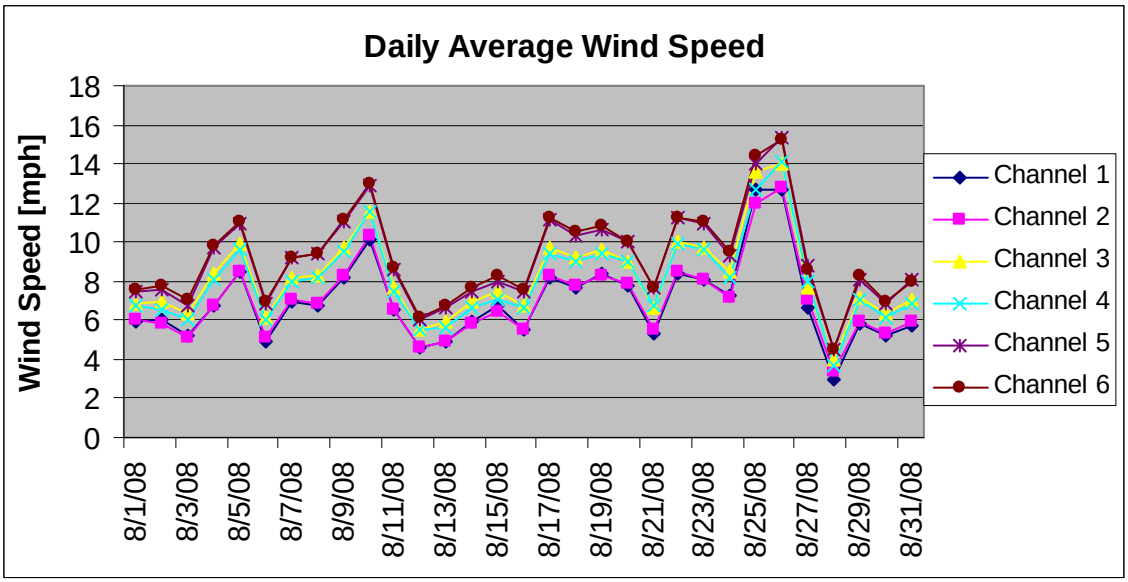
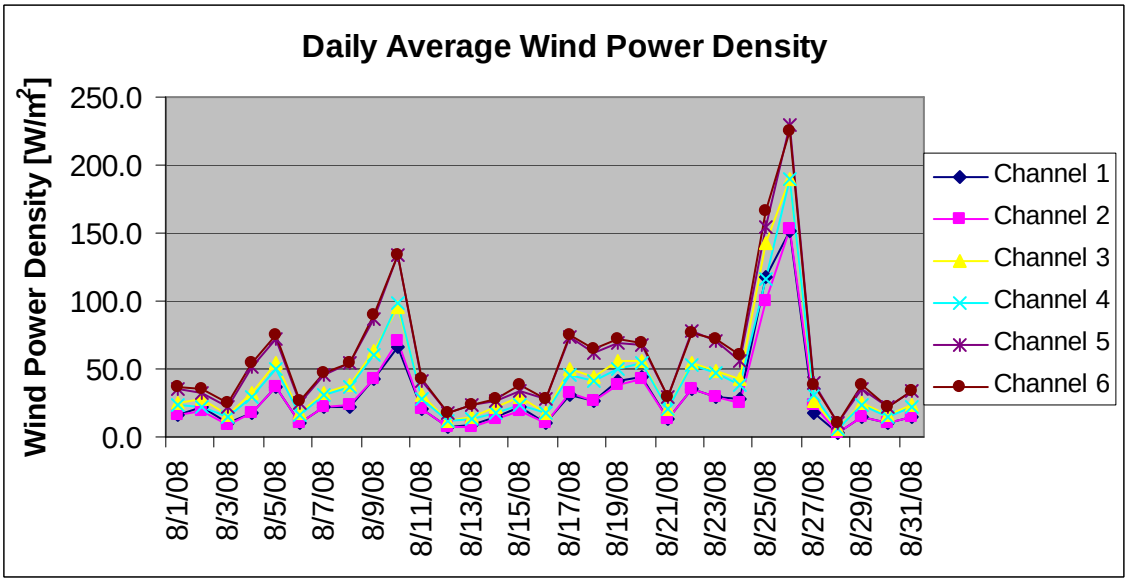


Figure 2: Daily Average Wind Power Density for August 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in August 2007, the monthly average wind speed and power density have continued to increase into the winter months and have decreased through the summer, with the exception of December and February in which measured wind speed values were lower than expected.

Figure 3: Monthly Average Wind Speeds

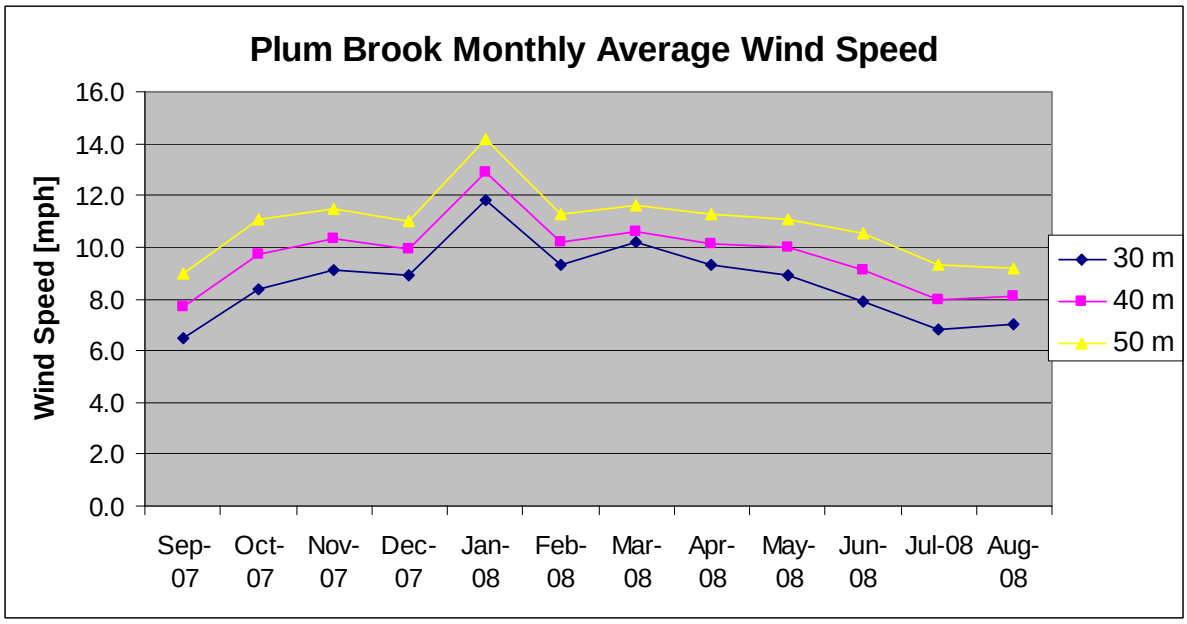
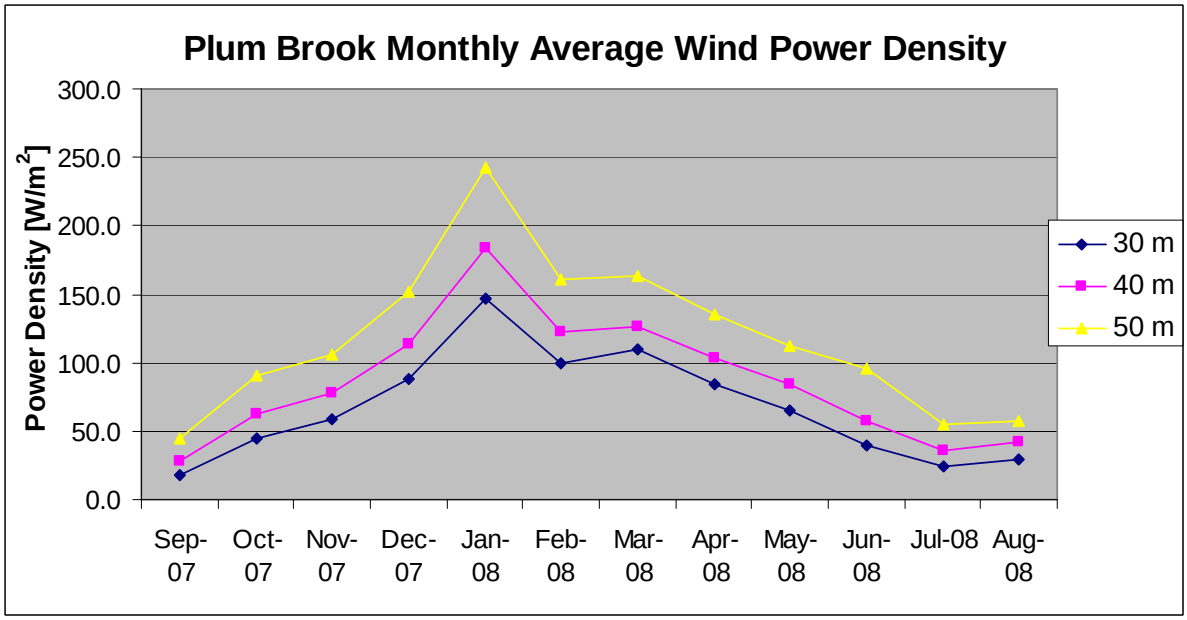


Figure 4: Monthly Average Wind Power Density



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Site Location (GPS coordinates):	N 41.3716°; W 82.6503°
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
	Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell

Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES; tower orientation was 221 degrees on the ground

INCIDENT LOG

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however, channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.

3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.

3/12/2008: Loss of data from channel 2 beginning at 11:00 p.m. and continuing through 5/1/2008 at 12:10 p.m. when a damaged wire was repaired.

4/21/2008: Loss of data from channel 10 beginning at 10:30 p.m. and continuing through 5/1/2008 at 12:50 p.m. when a damaged wire was repaired and changed to the channel 9 port.

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7/16/2008: Kemp Jaycox made the following repairs (approx. 11:30 a.m.):

1. Ch. 5 anemometer – cleaned, stripped and reattached this cable which had been pulled from the wiring panel on the logger box
2. Ch. 6 anemometer – cleaned, stripped and reattached this cable which had been severed in half
3. Switched temperature sensor and SCM card from Ch. 9 to Ch. 10
4. Ch. 7 & 8 vanes – cleaned, stripped and reattached these cables. They were frayed at their attachment point to the wiring panel.
5. Added new color ID tape to several cables.
6. Raised and tightened spool containing the cables. This had been pulled down and several cables were unraveled by our friendly critter.
7. Applied 2” electrical tape around the spool which will hopefully prevent the critter from biting into any more cables until we can install a more permanent fix.
8. Added zip ties and other electrical tape to secure and tighten the cables and grounding wire in various locations.

NASA Plum Brook Station
Wind Assessment Study
September 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data recovery issues for the month of September include loss of four days (September 4-7) of data from the memory card. Investigation into the loss revealed no problems with the data logger or data cards, which leads us to suspect that the card was not properly seated in the logger and therefore was making sporadic connection for download of the daily files. One other data recovery issue was the passing of the remnants of hurricane Ike. Due to the rarity and intensity of the event, the data collected during the event were omitted, so as to avoid unrealistically high wind speed averages.

Data determined to be uncharacteristic of the site due to the passage of the remnants of hurricane Ike were filtered from 7:10 a.m. until 11:50 p.m. on 9/14/2008. Based on a review of the data and weather maps for the site vicinity, 7 a.m. appears to represent the last time of day on 9/14/08 that the site vicinity was not yet significantly impacted by the hurricane remnants. Figure 1 below is a weather map depicting conditions at 7 a.m., which illustrates the encroaching of the low pressure system that was hurricane Ike. The spaces between isobars, (red lines of equal pressure) indicate changing pressure and wind speeds. As Ike approaches the isobars move closer together, which is indicative of high wind speeds influencing the area. See Figure 2, for a plot of 10-minute average wind speeds as recorded by the logger. Again, 7 a.m. is the point at which wind speeds begin to increase.

Figure 1: Daily Surface Weather Map for 7:00 a.m. E.S.T., September 14, 2008, created by the National Center for Environmental Prediction

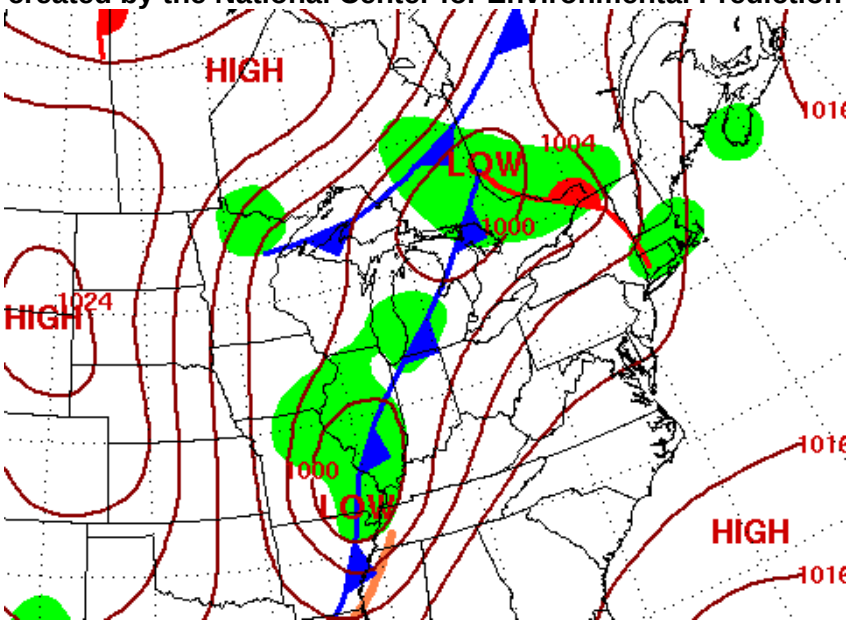
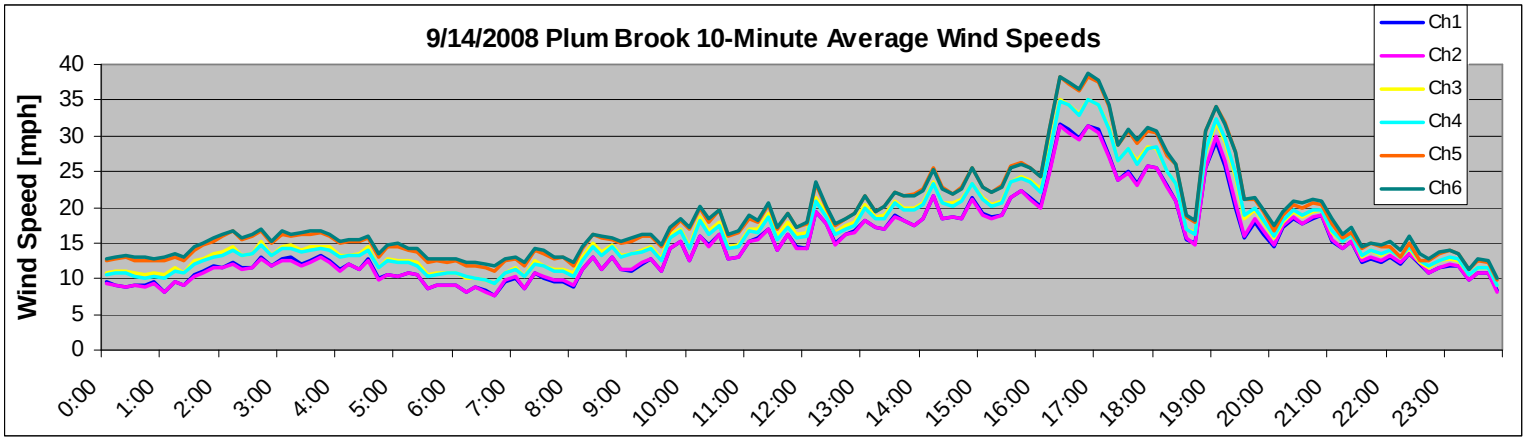


Figure 2: 10–Minute Average Wind Speeds Recorded at the Plum Brook site on 9/14/2008



Preliminary results for the month of September 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of September are summarized below in Table 1 and Figures 3 and 4.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m^2)	Monthly Turbulent Intensity
1	98	29.9	201	6.9	3.1	8.3	3.7	30.0	0.25
2	98	29.9	291	6.9	3.1	8.3	3.7	29.5	0.24
3	131	39.9	201	8.1	3.6	9.3	4.2	42.2	0.20
4	131	39.9	291	7.9	3.5	9.1	4.1	39.5	0.20
5	164	50.0	201	9.1	4.0	10.2	4.6	55.7	0.19
6	164	50.0	291	9.1	4.1	10.3	4.6	57.1	0.18

Shear Exponent	Channels	Exponent from Average of Wind Shear Column	Exponent from Average Wind Speed
Exp1	1 to 3	0.6804	0.5550
Exp2	3 to 5	0.5033	0.4937
Exp3	2 to 4	0.5522	0.4665
Exp4	4 to 6	0.6502	0.6199

Wind shear values for September 2008 data are high. Wind shear is a measure of how the wind speed profile changes with height. The wind shear exponent normally takes a value of approximately 0.143 for clear, topographically level, open land.[1] At this time, the cause of the high values measured at the Plum Brook site is unknown but likely results from tree cover in the area around the monitoring tower which is greatly reducing the wind speed at the lower monitoring heights. Note that the monthly summaries contain unfiltered, raw data; after filtering tower shadowing effects (i.e., where wind originates from a non-prevailing wind direction and encounters the monitoring tower before the instruments and thus the wind speed is decreased by the tower) the wind shears may represent more realistic values.

[1] *Wind Resource Assessment Handbook: Fundamentals for Conducting a Successful Wind Monitoring Program*, AWS Scientific, Inc., April 1997.

Figure 3: Daily Average Wind Speeds for September 2008

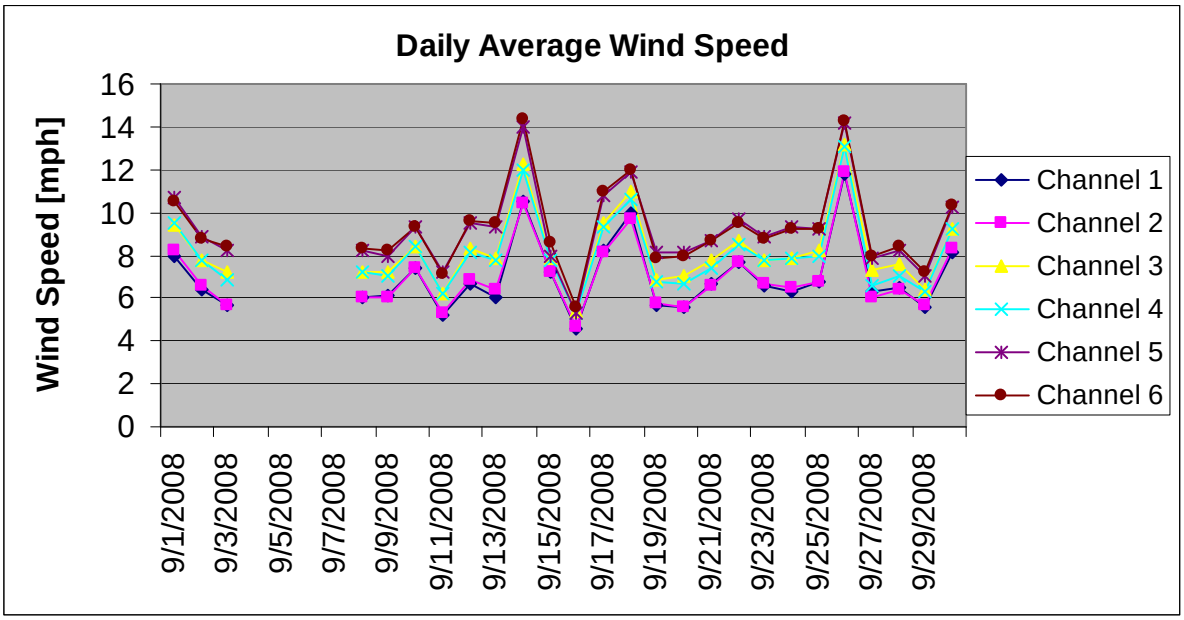
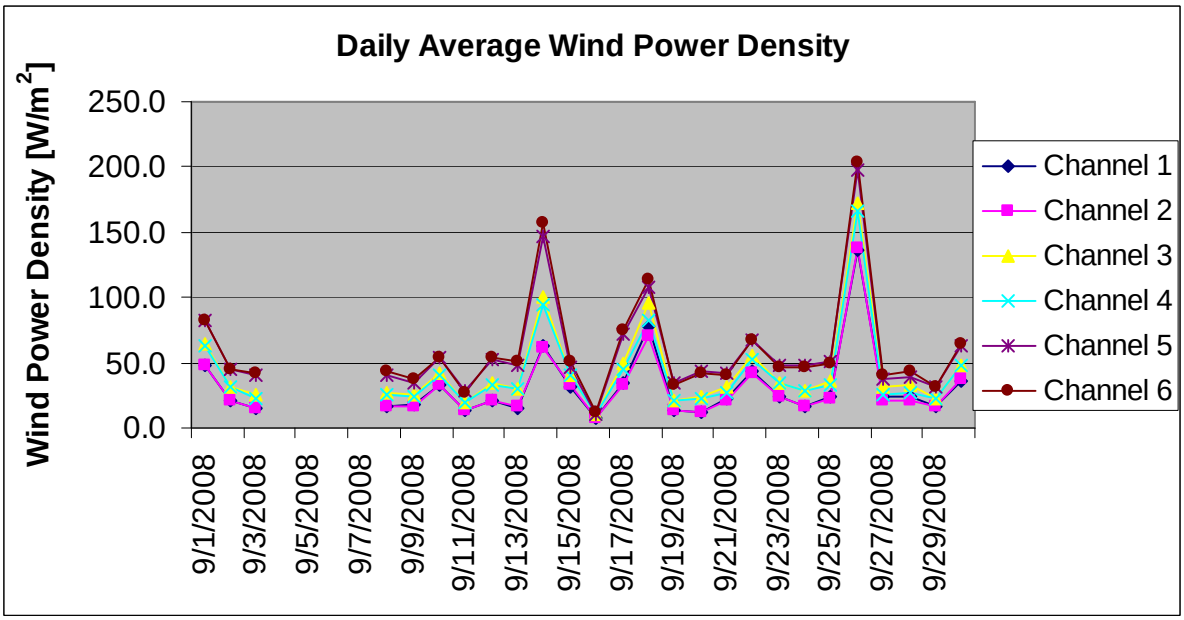


Figure 4: Daily Average Wind Power Density for September 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in August 2007, the monthly average wind speed and power density have continued to increase into the winter months and have decreased through the summer, with the exception of December and February in which measured wind speed values were lower than expected.

Figure 5: Monthly Average Wind Speeds

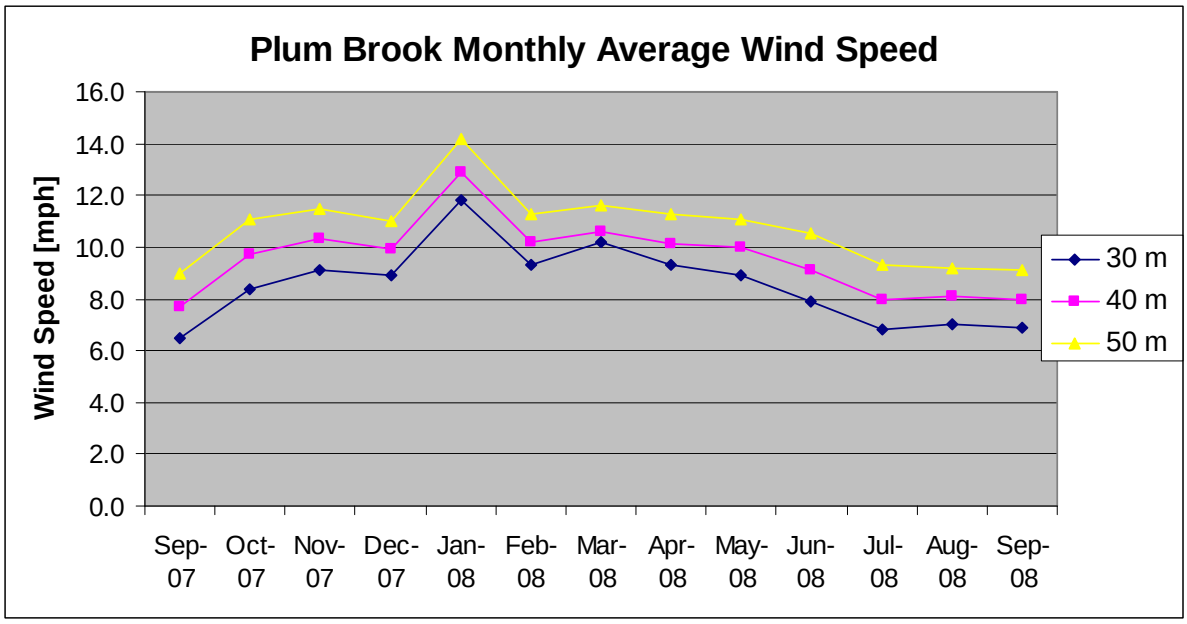
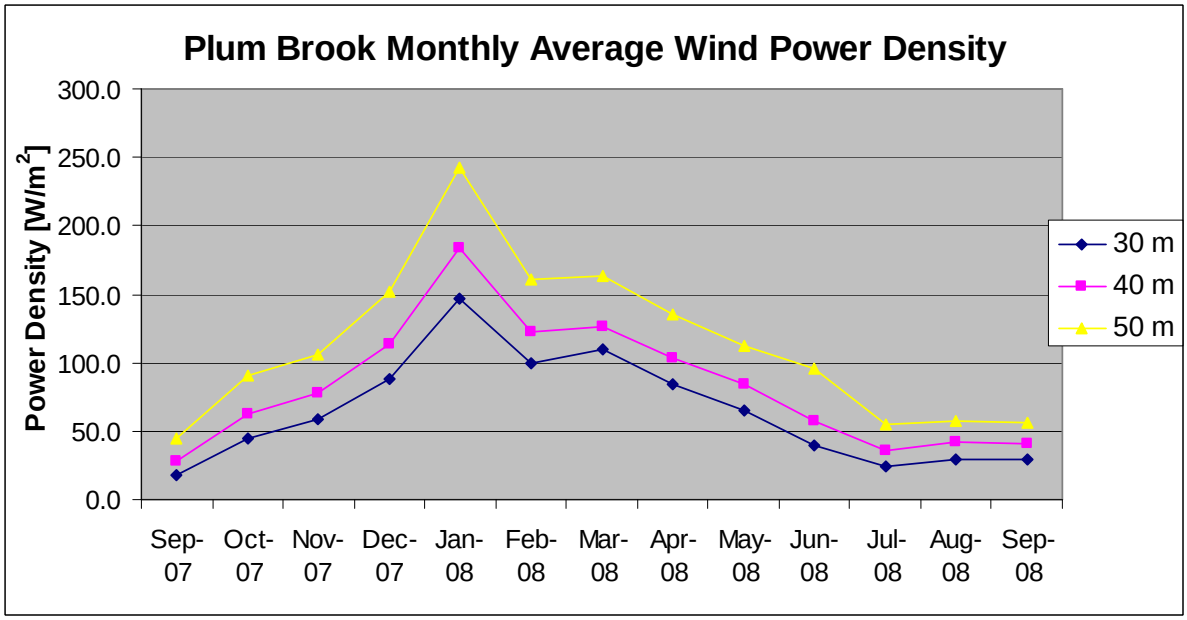


Figure 6: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name:	NASA Plum Brook Station
Installation Date:	August 21 and 22, 2007
Tower Owner:	Green Energy Ohio
Site Location (description):	Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates):	N 41.3716°; W 82.6503°
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
	Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell

Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
8	Red-White	NRG 200P Vane	329	160	201	21
9	N/A	N/A	N/A	N/A	N/A	N/A
10	Blue-White	NRG Temp Sensor	206	7	0	

NOTES: tower orientation was 221 degrees on the ground

INCIDENT LOG:

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however, channel 8 did not recover until the morning of 12/18/2007.

2/1/2008: Icing event caused failure of channels 1-8 from 0510 through 1150.

2/6/2008: Icing event caused failure of channels 1-8 from 1430 through 1100 on 2/8/2008.

2/26/2008: Icing event caused failure of channels 1, 4, and 7 from 0000 through 0620.

3/4/2008-3/6/2008: Icing event caused failure of channels 3 and 6 from 4:10 a.m. on the 4th through 8:40 a.m. on the 6th and occasional failure of channels 1, 2, 4, 5, 7, and 8 for the period.

3/12/2008: Loss of data from channel 2 beginning at 11:00 p.m. and continuing through 5/1/2008 at 12:10 p.m. when a damaged wire was repaired.

4/21/2008: Loss of data from channel 10 beginning at 10:30 p.m. and continuing through 5/1/2008 at 12:50 p.m. when a damaged wire was repaired and changed to the channel 9 port.

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7/16/2008: Kemp Jaycox made the following repairs (approx. 11:30 a.m.):

1. Ch. 5 anemometer – cleaned, stripped and reattached this cable which had been pulled from the wiring panel on the logger box
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5. Added new color ID tape to several cables.
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8. Added zip ties and other electrical tape to secure and tighten the cables and grounding wire in various locations.

9/4/2008-9/7/2008: Loss of data from data card due to unknown causes.
9/14/2008: Remnants of Hurricane Ike pass through Ohio, data omitted for affected period (7:10 a.m. – 11:50 p.m.).

NASA Plum Brook Station
Wind Assessment Study
October 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. There were no data recovery issues for the month of October.

Preliminary results for the month of October 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of October are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	8.1	3.6	9.4	4.2	44.9	0.24
2	98	29.9	291	8.1	3.6	9.4	4.2	45.1	0.24
3	131	39.9	201	9.4	4.2	10.6	4.8	64.9	0.21
4	131	39.9	291	9.2	4.1	10.5	4.7	63.3	0.21
5	164	50.0	201	10.4	4.7	11.7	5.2	87.3	0.19
6	164	50.0	291	10.5	4.7	11.9	5.3	90.9	0.18
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.5669	0.5088						
Exp2	3 to 5	0.4352	0.4634						
Exp3	2 to 4	0.4321	0.4306						
Exp4	4 to 6	0.6454	0.6004						

Figure 1: Daily Average Wind Speeds for October 2008

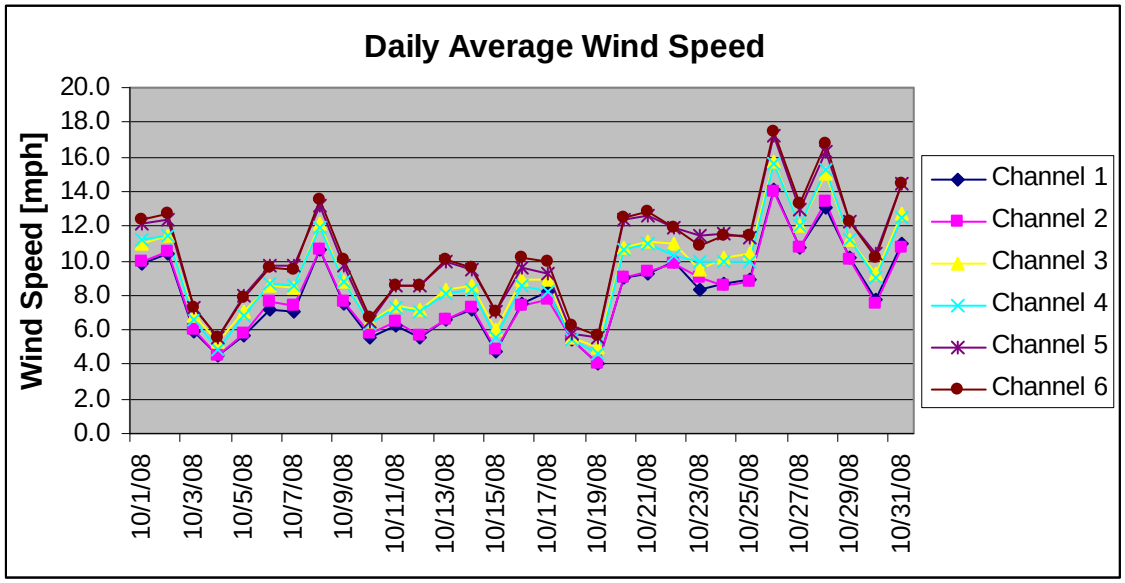
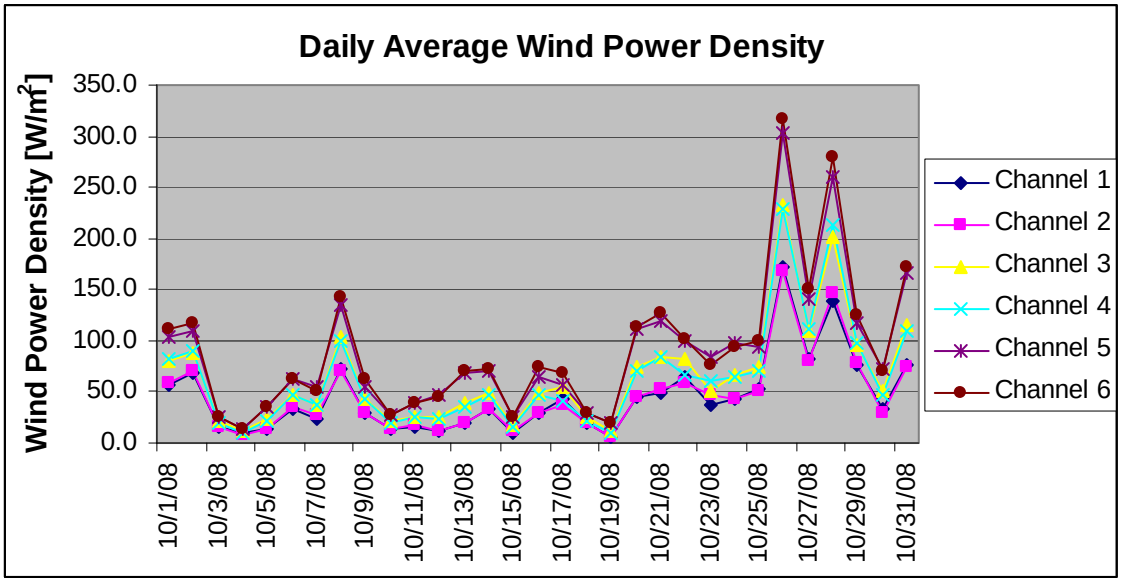


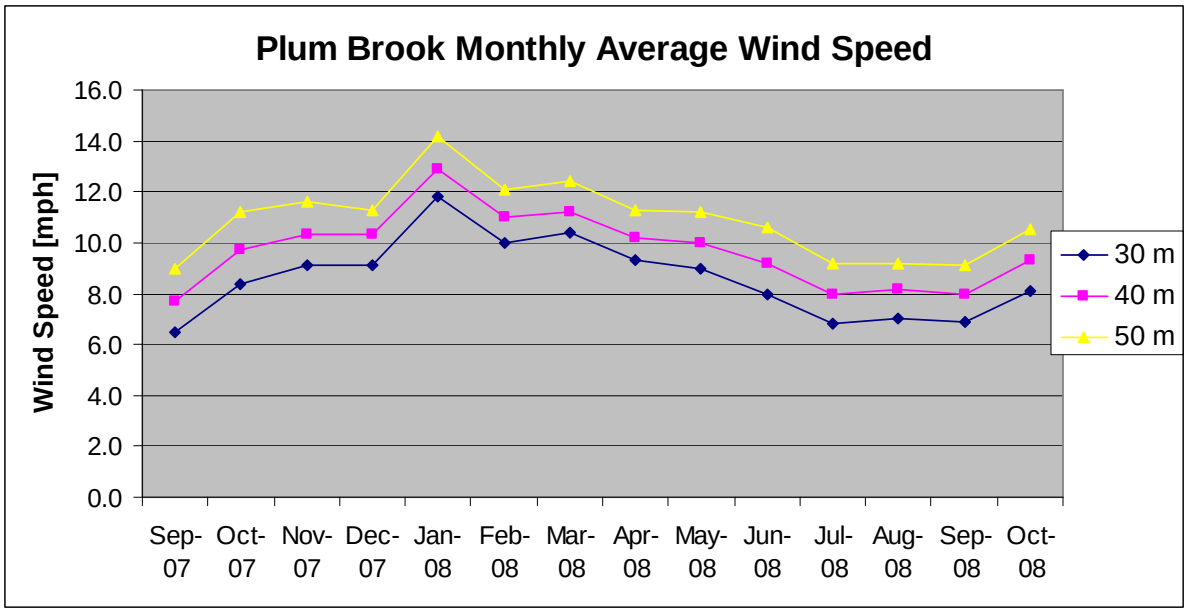
Figure 2: Daily Average Wind Power Density for October 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in August 2007, the monthly average wind speed and power density increased during the winter months and decreased through the summer of 2008. As the study continues through fall 2008, wind speeds and wind power densities are beginning to increase. We expect this trend to continue through winter.

Figure 3: Monthly Average Wind Speeds



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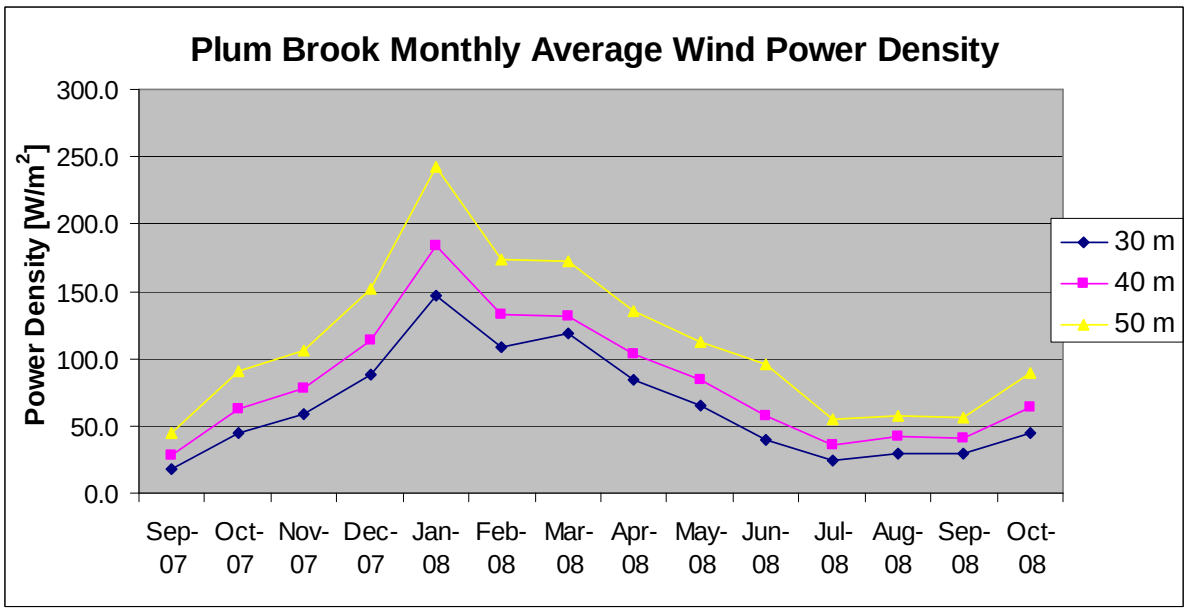

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Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
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Logger Lock Combination: N/A

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FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
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Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
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5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
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9/14/2008: Remnants of Hurricane Ike pass through Ohio, data omitted for affected period (7:10 a.m. – 11:50 p.m.).

NASA Plum Brook Station
Wind Assessment Study
November 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. There were no data recovery issues for the month of November.

Preliminary results for the month of November 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

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1	98	29.9	201	9.0	4.0	10.2	4.6	59.0	0.23
2	98	29.9	291	9.1	4.1	10.3	4.6	59.7	0.22
3	131	39.9	201	10.3	4.6	11.4	5.1	81.0	0.19
4	131	39.9	291	10.2	4.6	11.4	5.1	81.2	0.19
5	164	50.0	201	11.4	5.1	12.5	5.6	107.4	0.18
6	164	50.0	291	11.6	5.2	12.8	5.7	114.9	0.17

Shear Exponent	Channels	Exponent from Average of Wind Shear Column	Exponent from Average Wind Speed
Exp1	1 to 3	0.5495	0.4605
Exp2	3 to 5	0.4289	0.4376
Exp3	2 to 4	0.4280	0.3987
Exp4	4 to 6	0.6046	0.5678

Figure 1: Daily Average Wind Speeds for November 2008

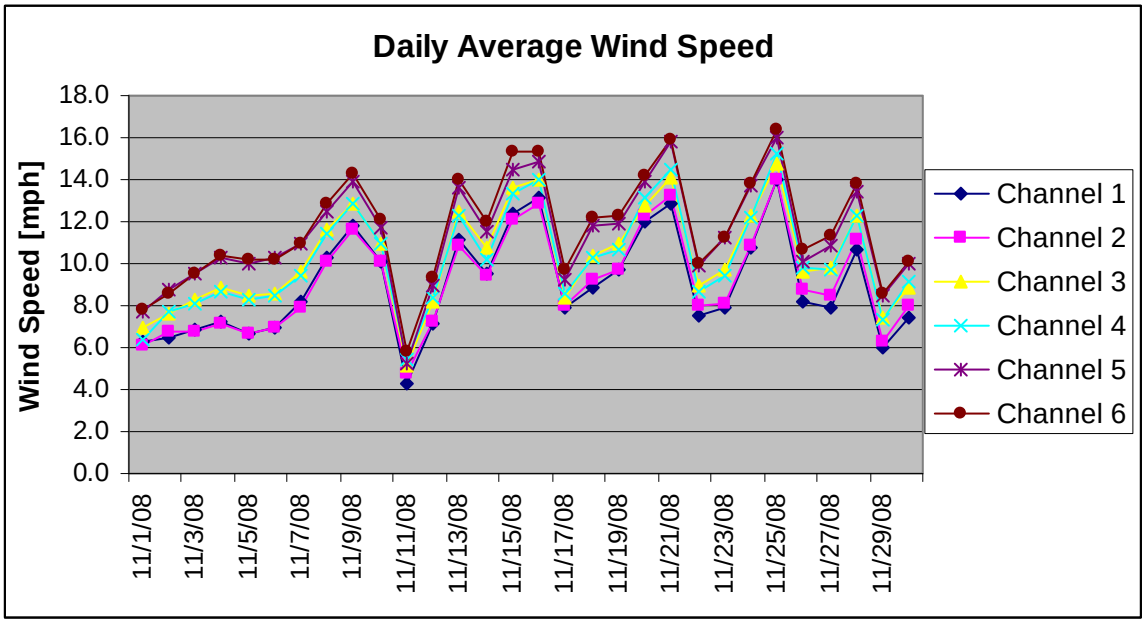
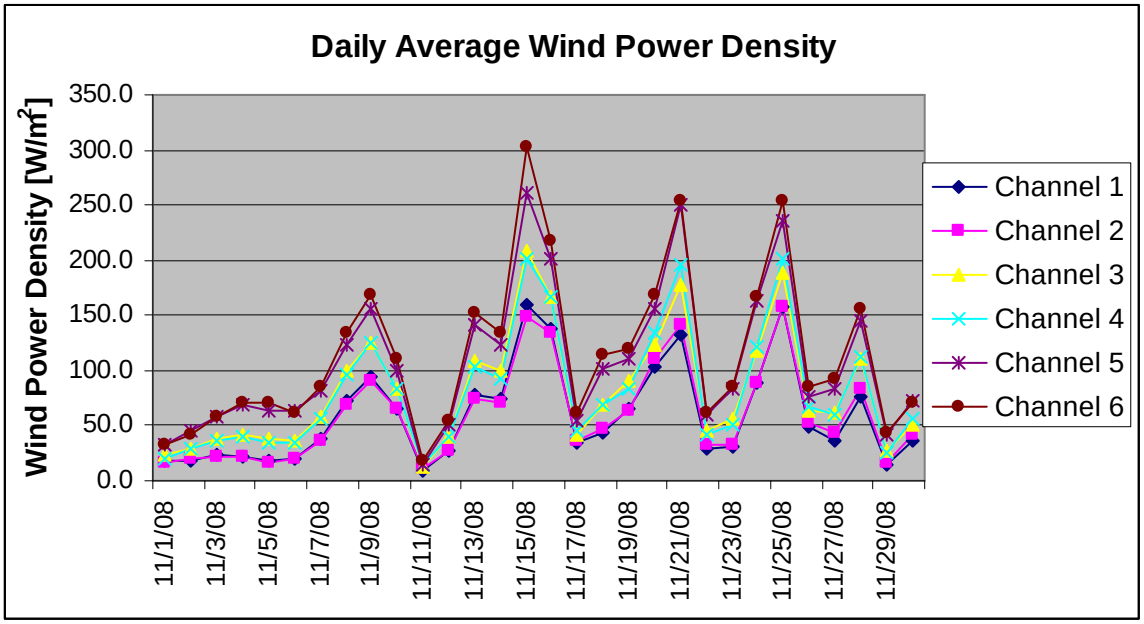


Figure 2: Daily Average Wind Power Density for November 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in September 2007, the monthly average wind speed and power density increased during the winter months and decreased through the summer of 2008. As the study continues through fall 2008, wind speeds and wind power densities are beginning to increase. We expect this trend to continue through winter.

Figure 3: Monthly Average Wind Speeds

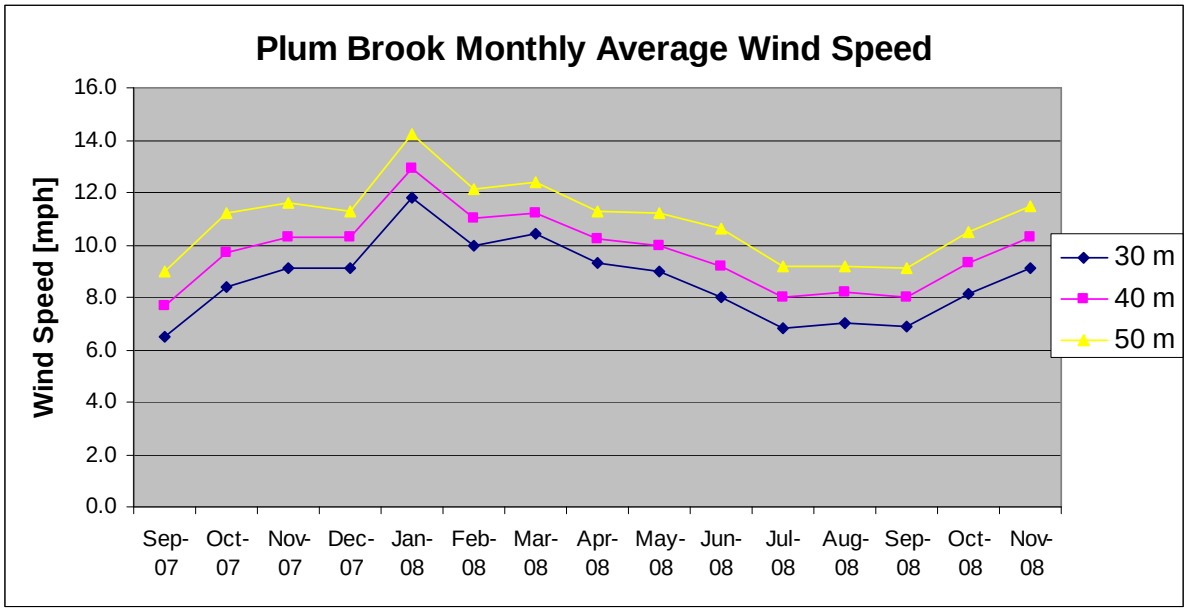
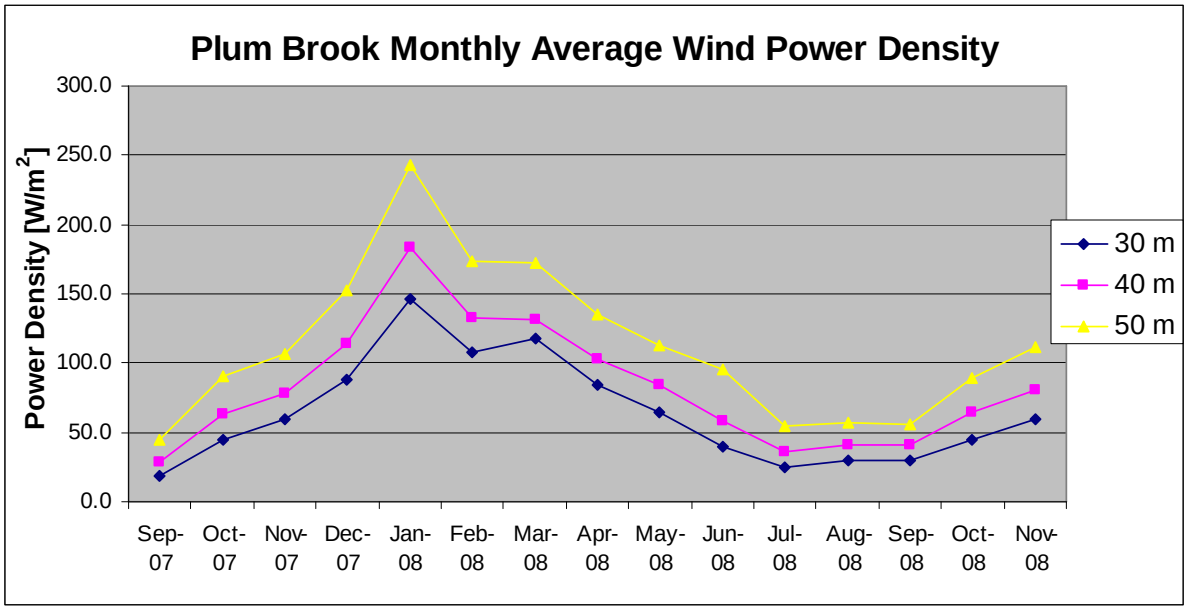


Figure 4: Monthly Average Wind Power Density



APPENDIX A: SITE SPECIFICATION LOG – NASA PLUM BROOK STATION

Site Name:	NASA Plum Brook Station
Installation Date:	August 21 and 22, 2007
Tower Owner:	Green Energy Ohio
Site Location (description):	Erie Co.; 280 yards SSW of intersection, Fox Rd and Patrol Rd.
Site Location (GPS coordinates):	N 41.3716°; W 82.6503°
Ground Elevation:	696 ft
Prevailing Wind Direction:	202.5° (from Ohio Wind Explorer)
Site Sponsor Contacts:	Bob Puzak, NASA Infrastructure Mgr: 419-621-3204 office, 216-701-0458 cell
	Rosemary Giesser, Environmental Specialist: 419-621-3250 office, 440-454-5660 cell

Logger Lock Combination: N/A

TOWER

FCC Tower Registration:	None - (50 meter temporary met tower)
Height of structure:	164 ft
Nominal Boom Heights:	30M, 40M, 50M (98ft, 131ft, 164ft) (heights above ground)

INSTRUMENTATION

Data Logger: NRG Symphonie, Serial Number: 6190

Sensors:

Logger Channel	Color Code	Instrument	Serial Number	Height (ft)	Boom Azimuth (degrees)	Deadband Azimuth (degrees)
1	Yellow	NRG Max 40 Anemometer	125	98	201	
2	Blue	NRG Max 40 Anemometer	123	98	291	
3	Green	NRG Max 40 Anemometer	149	131	201	
4	White	NRG Max 40 Anemometer	101	131	291	
5	Red	NRG Max 40 Anemometer	126	164	201	
6	Yellow-White	NRG Max 40 Anemometer	32450	164	291	
7	Green-White	NRG 200P Vane	330	127	201	21
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9	N/A	N/A	N/A	N/A	N/A	N/A
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NOTES: tower orientation was 221 degrees on the ground

INCIDENT LOG:

12/16/2007: Icing event caused failure of channels 1-8. Channels 1-7 recovered by midnight; however, channel 8 did not recover until the morning of 12/18/2007.

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9/4/2008-9/7/2008: Loss of data from data card due to unknown causes.
9/14/2008: Remnants of Hurricane Ike pass through Ohio, data omitted for affected period (7:10 a.m. – 11:50 p.m.).

NASA Plum Brook Station
Wind Assessment Study
December 2008 Monthly Summary Report

Prepared by:

Emily Sautter, Green Energy Ohio, Wind Program Coordinator
Kemp Jaycox, Green Energy Ohio, Wind Program Manager

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1. Site Status

Wind monitoring data collection continues at NASA Plum Brook Station. Data recovery issues for the month of December include a few icing events. The icing events took place on the following dates December 10-11, 17-18, 19-23, 23-24 and affected various channels throughout the duration of the events (see incident log in Site Specification Log for details).

Preliminary results for the month of December 2008 are summarized in Section 2. A short summary of the study to date can be found in Section 3. Specifications for the NASA PBS Test Site are included in the Appendix A (Site Specification Log).

2. Monthly Data Analysis Summary

Wind data collected during the month of December are summarized below in Table 1 and Figures 1 and 2.

Table 1: Summary of Monthly Average Wind Speed, Power Density and Turbulent Intensity.

Channel	Height (feet)	Height (meters)	Boom Orientation (degrees)	Monthly Average Wind Speed (mph)	Monthly Average Wind Speed (m/s)	Cubic Average Wind Speed (mph)	Cubic Average Wind Speed (m/s)	Monthly Wind Power Density (W/m2)	Monthly Turbulent Intensity
1	98	29.9	201	11.3	5.1	13.6	6.1	140.1	0.26
2	98	29.9	291	11.3	5.0	13.6	6.1	137.7	0.25
3	131	39.9	201	12.5	5.6	14.9	6.7	184.1	0.23
4	131	39.9	291	13.0	5.8	15.3	6.8	196.6	0.22
5	164	50.0	201	13.9	6.2	16.4	7.3	244.8	0.21
6	164	50.0	291	13.9	6.2	16.5	7.4	247.4	0.21
Shear Exponent	**Channels**	**Exponent from Average of Wind Shear Column**	**Exponent from Average Wind Speed**						
Exp1	1 to 3	0.3266	0.3482						
Exp2	3 to 5	0.4267	0.4455						
Exp3	2 to 4	0.4119	0.4918						
Exp4	4 to 6	0.3567	0.3016						

Figure 1: Daily Average Wind Speeds for December 2008

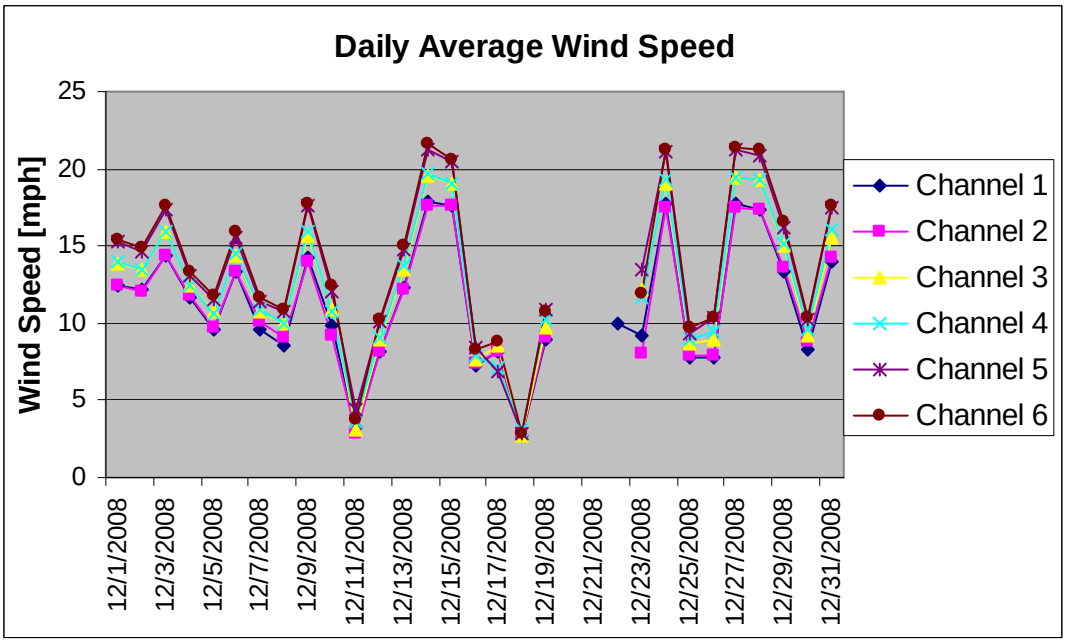
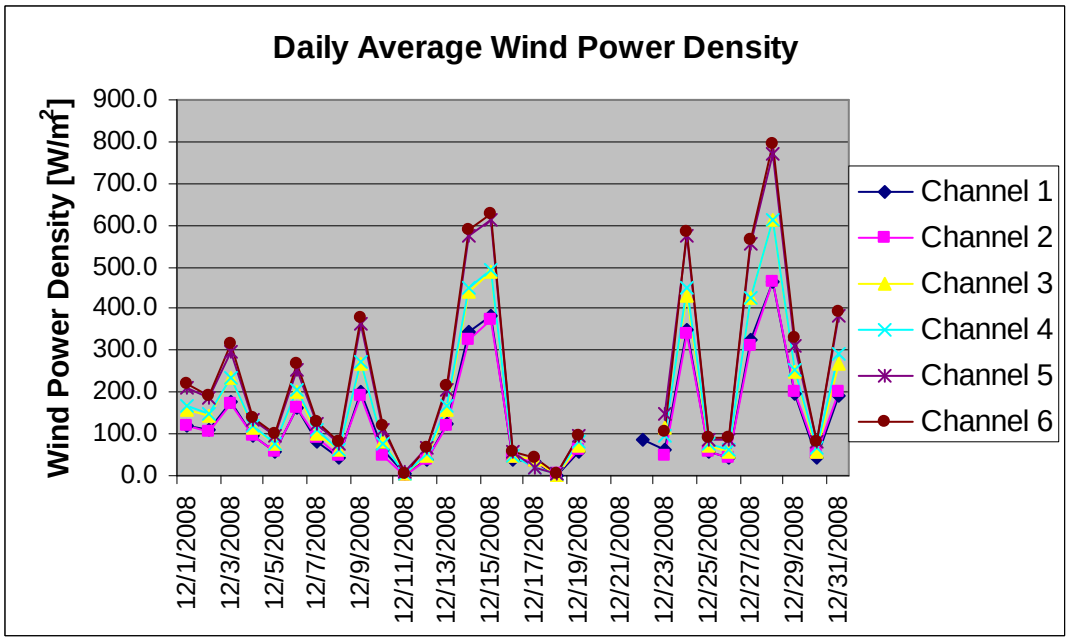


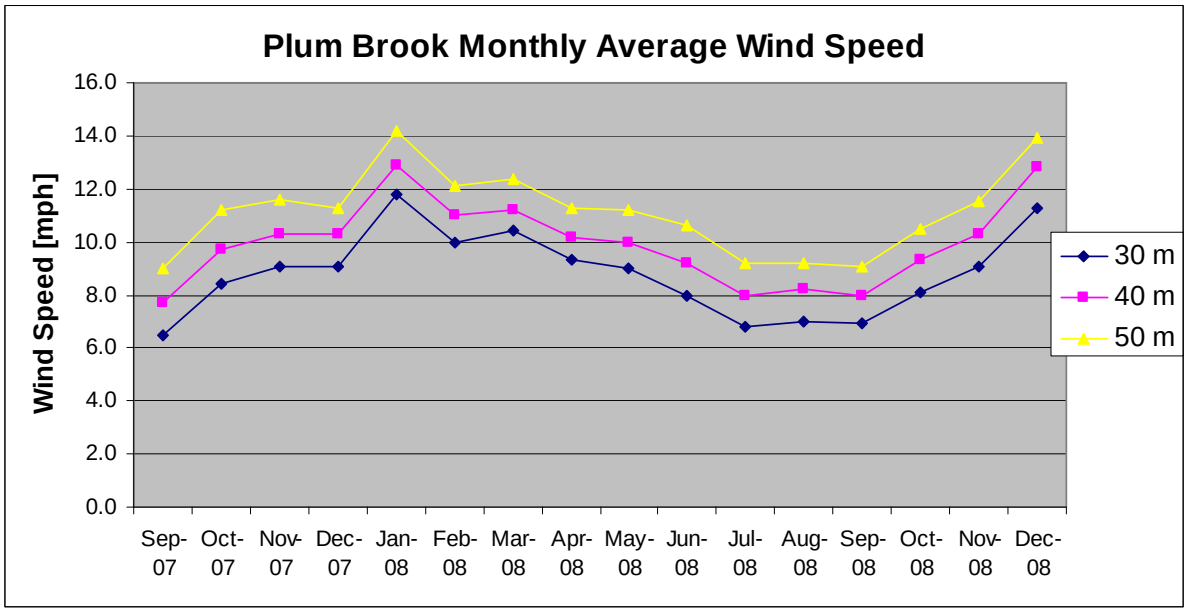
Figure 2: Daily Average Wind Power Density for December 2008



3. Data Analysis Summary (study to date)

Figures 3 and 4 display monthly average wind speed data and monthly average wind power density data for the study to date. Since the study began in September 2007, the monthly average wind speed and power density increased through fall and winter 2007 to hit a maximum monthly average during January 2008. The wind speed then decreased through the summer of 2008. As the study continues through fall 2008, wind speeds and wind power densities are again increasing. We expect this trend to continue through winter, however, the wind speeds recorded for December 2008 are over 2 mph greater than those measured in December 2007. The difference is likely due to an abnormally windy December this year and an abnormally less windy December in 2007. A comparison to a historical data set in the final report should provide more insight.

Figure 3: Monthly Average Wind Speeds



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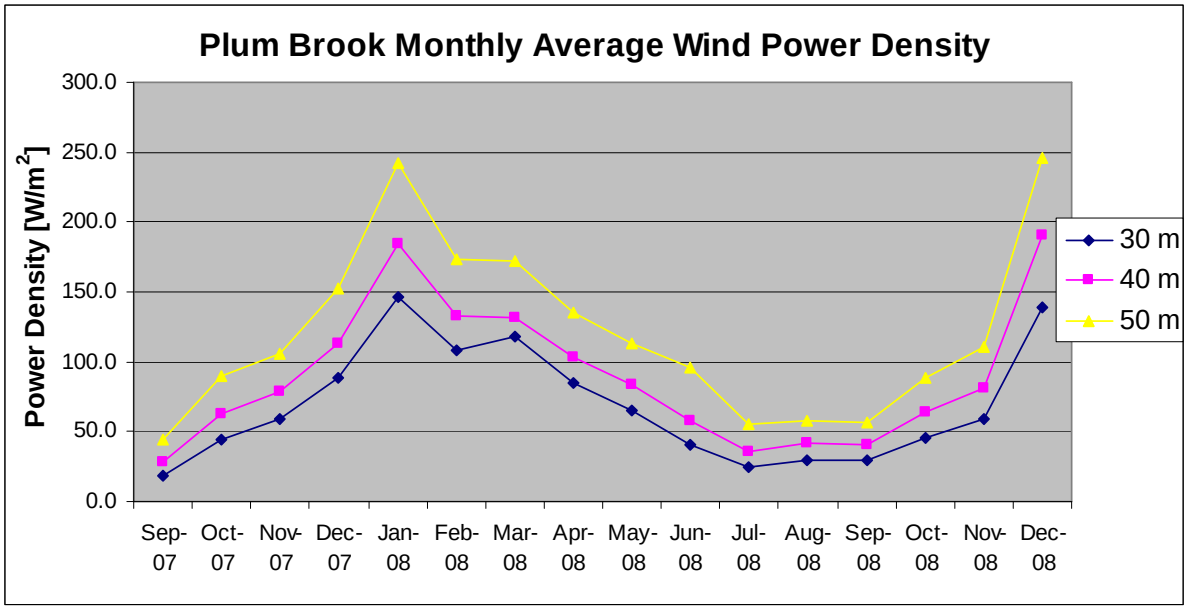

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12/10/2008-12/11/2008: Icing event affecting channel 7 & 8; began at 6:40 a.m. and ended at 12:30 p.m. on 12/11/2008

12/17/2008: Icing event affecting channels 1-3; began at 0:20 a.m. and ended at 5:40 a.m.

12/17/2008-12/18/2008: Icing event affecting channels 1-8; began at 0:20 a.m., channels 1-3 recovered at 5:40 a.m. on 12/17/2008, channel 7 recovered at 5:10 a.m. on 12/17/2008, channel 6 recovered at 10:40 a.m. on 12/17/2008, channel 5 recovered at 11:10 p.m. on 12/17/2008, channel 4 recovered at 10:50 a.m. on 12/18/2008, and channel 8 recovered at 6:40 p.m. on 12/18/2008.

12/19/2008-12/23/2008: Icing event affecting channels 1-8; began at 6:20 a.m., channel 1 recovered first at 12:00 p.m. on 12/22/2008, channel 2 recovered at 4:00 p.m. on 12/22/2008, channels 3 & 6 recovered at 7:30 a.m. on 12/23/2008, channel 7 recovered at 9:10 a.m. on 12/23/2008, channel 4 recovered at 9:20 a.m. on 12/23/2008, channel 5 recovered at 12:50 p.m. on 12/23/2008, channel 8 recovered at 2:00 p.m. on 12/23/2008.

12/23/2008-12/24/2008: Icing event affecting channels 1-8; began at 8:00 p.m. on 12/23/2008 and ended at 1:40 a.m. on 12/24/2008.